



REPORT ON THE
PROPOSED OPERATION OF
KITCHENER
WELL NO. 50 AND NO. 51
IN THE
HUNSBURGER CREEK AREA
TOWNSHIP OF WILMOT

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DIVISION OF WATER RESOURCES
JANUARY 1972

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INTRODUCTION

Purpose Of The Study

The Kitchener Water Commission has applied for a Permit To Take Water at a maximum rate of 2100 Imperial gallons per minute from two wells (No. 50 and No. 51). The wells are located outside the Kitchener municipal boundaries in the Hunsburger Creek basin near the community of Wilmot Centre in the Township of Wilmot.

An evaluation of data collected during an 18-day pumping test in April and May, 1970, indicated that production pumping of these wells could be expected to cause interference with the water level in private wells and ponds, and with streamflow in local watercourses. Local residents have repeatedly expressed their opposition to this proposed taking, which requires authorization by permit under Section 37 of The Ontario Water Resources Commission Act. They have been advised in general terms of the conditions to be included in the permit to protect existing uses of water.

Kitchener's application for a Permit To Take Water has been held in abeyance pending installation of the pumping equipment, and completion of studies by the OWRC of existing hydrologic conditions in the Hunsburger Creek area. The objective of these studies was to collect the information required to determine the proper terms and conditions to be included in the permit.

A surface-water availability study and a water-use inventory were undertaken by the Water and Well Management Branch, while the Biology Branch carried out a study of biological conditions in Hunsburger Creek. In addition, the periodic monitoring of the water levels in private wells and ponds, which began in 1970, was continued. The studies were co-ordinated by the Water and Well Management Branch, which administers the permit program.

The results of these studies are summarized in this report, and are followed by an outline of OWRC policy with respect to water-supply interference and the recommendations of the Division of Water Resources concerning the terms and conditions under which the Kitchener Water Commission should be authorized to operate Well No. 50 and No. 51.

Significance Of The Study

The conclusions and recommendations of this report apply directly to an area of less than 25 square miles in the Township of Wilmot. Indirectly, the study is felt to be of broader

significance, as it deals with reconciling urban ground-water development with protection of both the natural environment and private and public interests in water in a rural setting. The study can therefore be seen as relating in a broader context to basin management in the Grand River watershed. Indeed, the decisions made and the policies followed in the Hunsburger Creek area will be generally applicable to the Province as a whole, where problems of this nature can be expected to become more numerous.

It is important to remember that surface-and ground-water flow systems are not governed by municipal boundaries. The Hunsburger Creek study area is a notable example of a rural area adjacent to an urban area where hydrogeologic conditions have made it necessary for the urban area to install a high-capacity well in the rural municipality.

In order to resolve the resultant water-supply problems, it is necessary to evaluate the situation on the basis of hydrologic and not municipal boundaries. This is the basis which has been employed in this report.

Acknowledgements

The surface-water availability study and water-use inventory were carried out under the supervision of Messrs. R. Slaughter and D. Pirie, respectively, both of the Water and Well Management Branch, while the study of biological conditions in Hunsburger Creek was carried out under the supervision of Mr. D. Osmond of the Biology Branch.

A number of OWRC personnel assisted in the collection and compilation of field data.

Staff of the Kitchener Water Commission, Ontario Department of Agriculture and Food, Ontario Department of Lands and Forests and the Waterloo County Health Unit provided valuable information concerning various aspects of the study.

Mr. P. Dennis of the Water and Well Management Branch was responsible for co-ordination of the various studies and for preparation of the final report.

WATER AVAILABILITY STUDY

Introduction

Background History

The original source of water supply for Kitchener was Shoemaker Lake, which was established in 1888. In 1899, a ground-water supply was established near the original source on Shoemaker Avenue. Since the establishment of the water supply from wells at Shoemaker Avenue, test drilling has been carried out over a wide area within and surrounding Kitchener. In 1915, wells were drilled in the Bridgeport area, and in 1920 to 1923, a well field was developed in the Strange Street area. During the years 1942 to 1949, inclusive, an extensive test-drilling program was carried out in the areas within five miles of the city. This resulted in the location of aquifers in the Mannheim and Parkway areas. Four wells were constructed in the Mannheim area in the period 1950 to 1953, a fifth in 1962, and a sixth in 1970. The wells were put into production shortly after construction. The pumping from the wells in the Mannheim area over the past 17 years has resulted in a substantial reduction of base flows in Alder Creek.

Since Kitchener has been expanding rapidly the city has been forced to go farther from the city centre in order to obtain enough water to meet its needs. In 1967, test drilling was carried out in the Wilmot Centre area, which is approximately eight miles from Kitchener. Two production wells (No. 50 and No. 51) were drilled in 1970 in this area. Kitchener plans to place these wells in production in 1972, at a maximum combined rate of 2,100 Igpm.

Location, Purpose and Scope of the Water Availability Study

The location of the Hunsburger Creek area of study is shown in Figure 1. The purpose of the water-availability study was to evaluate the quantities of streamflow presently available in the Hunsburger Creek area. A distinction is made between the Hunsburger Creek basin above the weir installation, which was studied in detail, and the Hunsburger Creek area of study, where the surface-water availability was evaluated in more general terms. The weir site is shown on Figure 2.

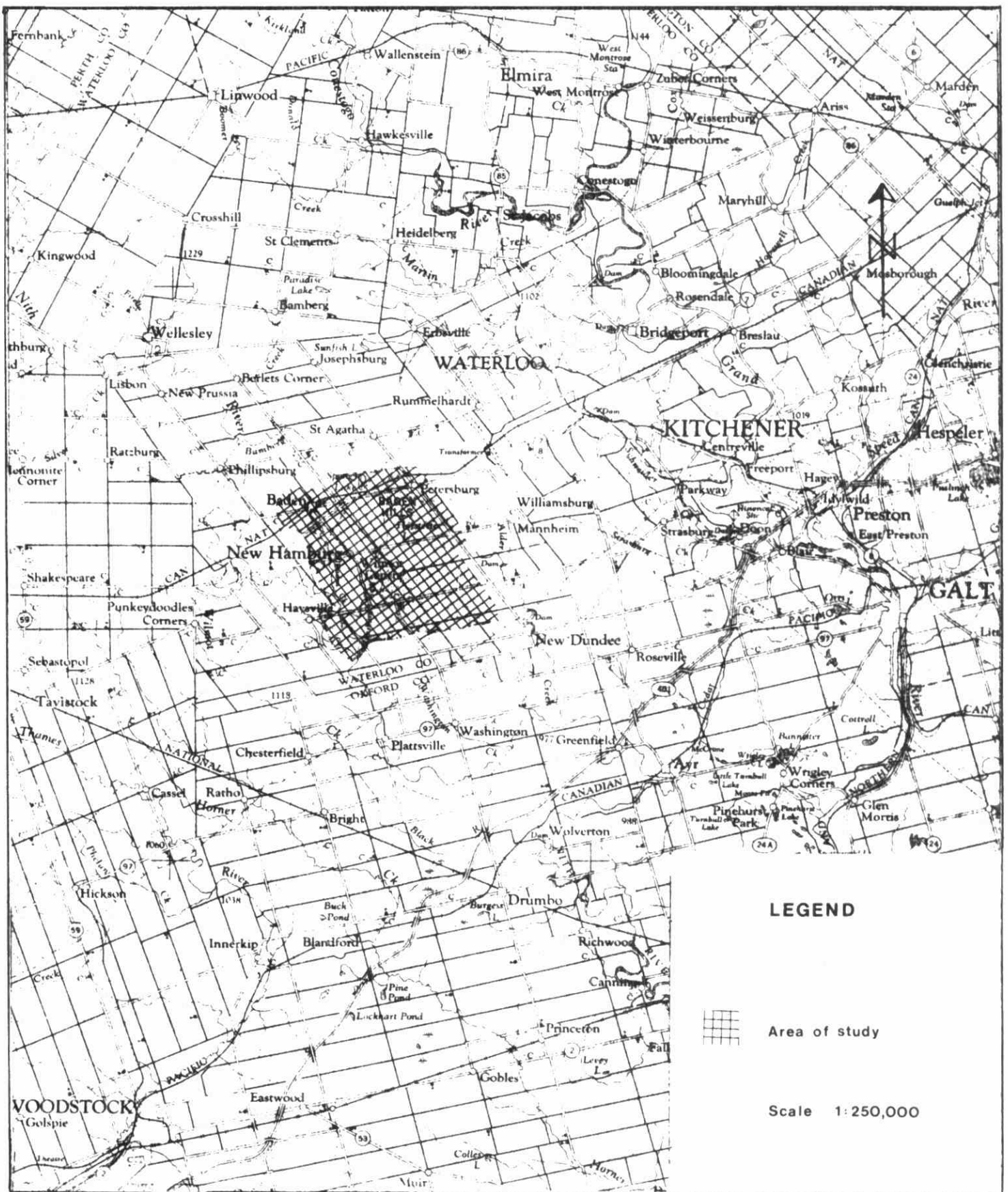


Figure 1. Location map of the water-availability study area.

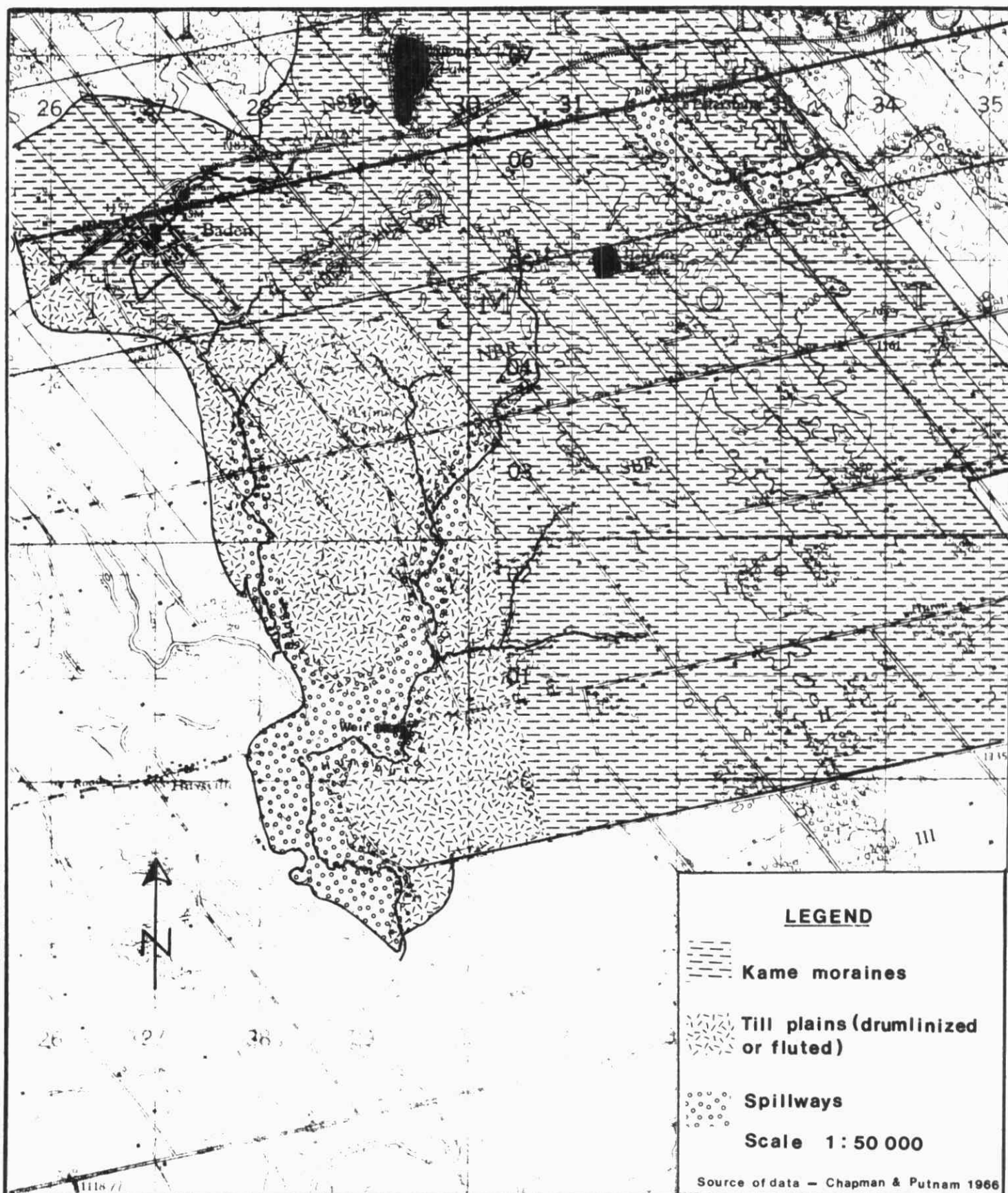


Figure 2. Physiography of the water - availability study area.

The Hunsburger Creek basin above the weir site, which has a drainage area of 5.43 square miles, has been divided into five sub-basins and the surface water available from each basin has been documented giving the naturally-occurring minimum instantaneous, the minimum day and the seven-day minimum flows using the period of record from June 17, 1971, to September 30, 1971. Water available in each sub-basin is presented in detail, giving the base flows available in many sections of each sub-basin, and specifying areas of ground-water discharge to surface streams.

Within the general area of study, comments on the water available in Baden Creek and its tributaries, some of the upper Alder Creek tributaries, and an unnamed tributary to the Nith River is presented. Also, the surface water available in Spongy Lake and Hofstetter Lake is documented and presented.

Climate, Physiography and Geology

Climate

The Hunsburger Creek study area is specifically described as being in the Huron Slopes Climatic Region (Brown et al, 1968). The mean daily temperature at the meteorological station in Kitchener for January is 21.7°F, and the mean daily temperature for July is 69.5°F. The normal annual precipitation for the above-mentioned station is 33.5 inches.

The actual precipitation from April to September, 1971, in the Hunsburger Creek Area is compared to the normal precipitation at the Kitchener station in Table 1. It should be noted that the precipitation from April to September of 1971, was 33.6% below normal at Kitchener. Also, precipitation data collected in the Hunsburger Creek Basin by Mrs. S. Shantz, who maintains a precipitation gauge for the Ontario Department of Agriculture and Food, indicate that precipitation on the basin was 24% below the normal at Kitchener.

Physiography

The Hunsburger Creek study area is located in the Waterloo Hills physiographic region (Chapman and Putnam, 1966). The surface is composed mainly of sandy hills, some of them being ridges of sandy till while others are kames or kame moraines, with outwash sands occupying the intervening hollows. A peculiar characteristic is the preponderance of fine sand, particularly on the surface.

Table 1. Precipitation Data - Kitchener Station and Hunsburger Creek Station

Month	Kitchener Normal Precipitation 1931 - 1960 Inches	Kitchener Precipitation 1971 Inches	% Deviation From Normal	Hunsburger Creek Basin Precipitation 1971 Inches (Shantz)	% Deviation From Kitchener Normal
April	2.72	1.12	- 58.8	2.68	- 1.5
May	3.17	1.38	- 56.5	1.19	-62.5
June	3.14	2.37	- 24.5	2.44	-22.3
July	3.41	3.25	- 4.7	3.17	- 7.0
August	2.77	3.23	+ 16.6	3.48	+25.6
September	3.02	0.75	- 75.1	0.85	-71.9
Total for 6 Months	18.23	12.10	- 33.6	13.81	-24.2

In the Hunsburger Creek study area, there are two kettle lakes, Spongy Lake and Hofstetter Lake, which are shown in Figure 2. The Baden Hills, which are kames 200 feet high consisting entirely of gravel and sand, (Chapman and Putnam, 1966) are located in the northern part of the Hunsburger Creek basin. The eastern part of the Hunsburger Creek study area is mainly kame moraines composed of sands and gravels. West of Hunsburger Creek is a till plain composed mainly of clay.

The elevation difference between the headwaters of Hunsburger Creek at the Baden Hills and the weir site is 360 feet in a distance of approximately 4.2 miles along the main stream. The stream has low banks ranging in height from approximately 2 to 5 feet in the sandy headwater areas up to approximately 7 to 9 feet at the weir site.

Geology

The surficial geology of the Hunsburger Creek Area is described specifically in Figure 3 (from Karrow, 1971). Deposits less than three feet thick are not shown on the map. The overburden materials consist of kame sands and gravels, overlain by a veneer of clay till which thickens towards the western portion of the study area.

It is evident that kame sands and gravels with good base flow properties are predominant at surface throughout most of the Hunsburger Creek basin. Base flow in streams from these sand and gravel areas is high, in the range of 0.4 to 1.5 cfs per square mile. Baden Creek basin is mainly overlain with clay till which has high runoff properties and low base flow. Most of the base flow in Baden Creek comes from the sand area at the headwaters of the basin.

Water Availability - General

Introduction

In this section, general surface-water availability is presented for Hunsburger Creek and its tributaries, Baden Creek and its tributaries, Upper Alder Creek and some of its western tributaries, an unnamed tributary of the Nith River, Hofstetter Lake, Spongy Lake and eleven small ponds. Where insufficient information is available, suggested sites for additional data collection are pointed out. The locations of ponds and stream-gauging sites are shown on Figure 4.

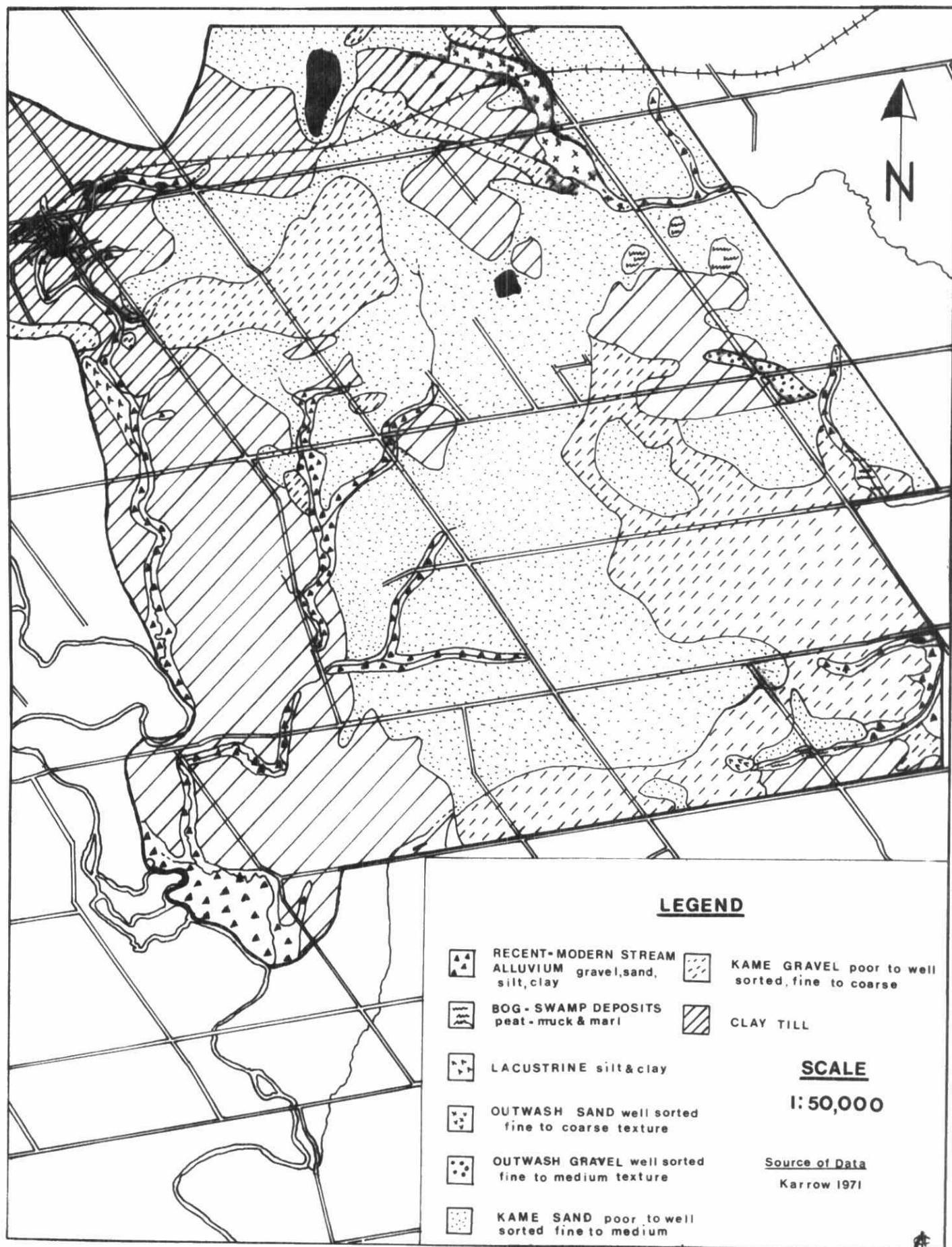


Figure 3. Surficial Geology of the Water - Availability Study Area

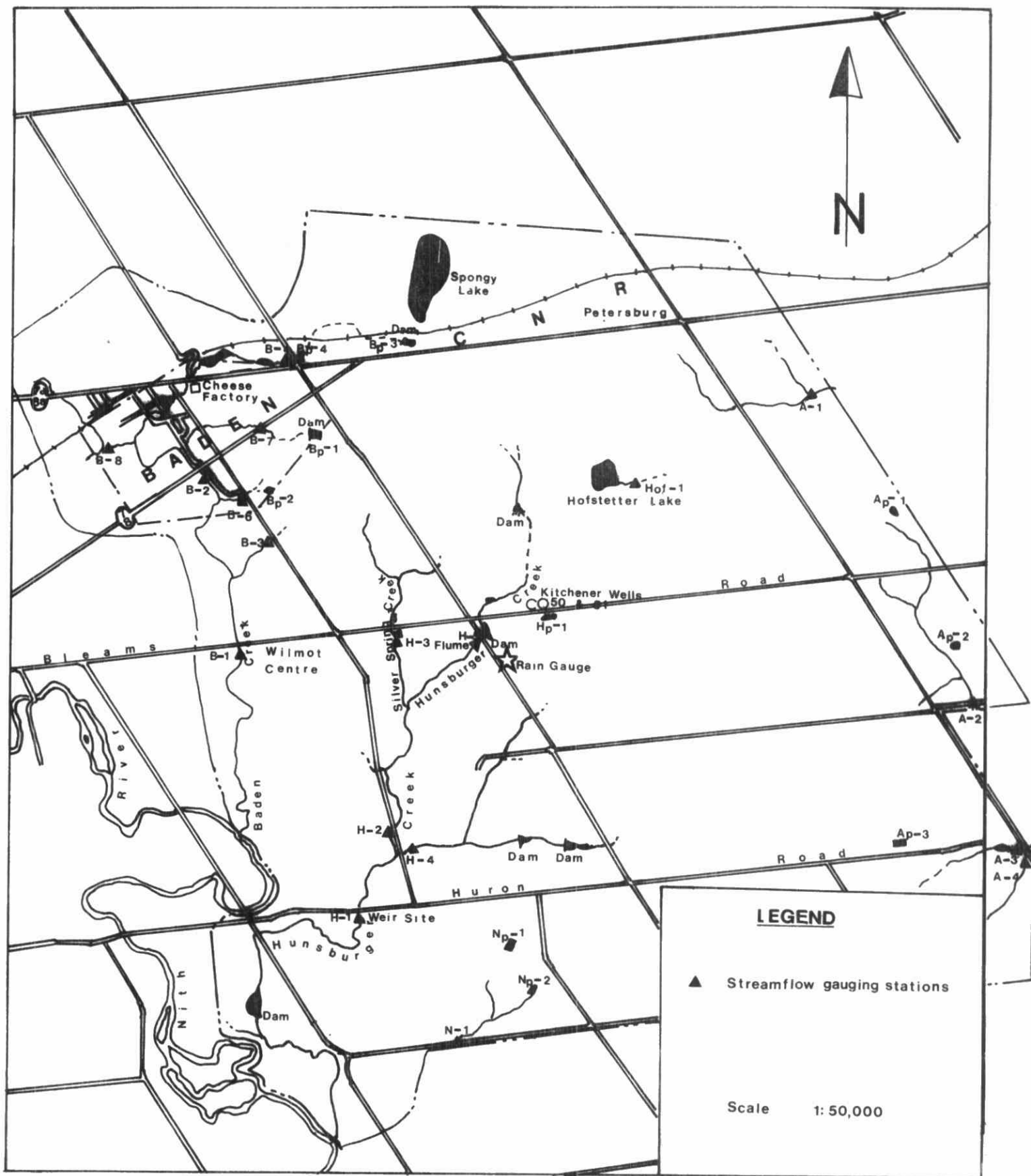


Figure 4. Location of ponds and stream-gauging sites in the water-availability study area.

There is generally medium-to-high base flow in streams in the sand and gravel area and zero-to-low base flow in streams in the clay till areas (see Figure 3). It should be noted that Kitchener Well No. 50 and No. 51 are located approximately in the centre of the study area in the Hunsburger Creek basin.

Baden Creek

Baden Creek at site B-1 had a base flow during June and July, 1971, of approximately 2.4 cfs which was 0.66 cfs per square mile. Flow at this point was affected slightly by discharge from the Baden Cheese factory estimated between 0.04 to 0.2 cfs for an instantaneous discharge. The base flow at site B-2 for the same period was approximately 2.7 cfs which was 1.1 cfs per square mile and was also affected by discharge from the cheese factory (See appendix A for detailed streamflow measurements). It appears that Baden Creek is slightly influent between sites B-2 and B-1. This may result because it flows through a clay till area. Alternatively, this condition could be explained by a combination of little or no ground-water discharge and evaporation losses. Most of the base flow in Baden Creek comes from the upper portion, northwest of the Baden Hills between sites B-4 and B-2.

There was no flow at site B-4 and B-7, and at times there was a trace of flow at B-6. B-5 had some base flow. One day after a rain, flow was estimated at 15 to 30 gpm at B-5. It is possible that during dry periods this stream may stop flowing at B-5. At B-8, no flow was observed on October 21, 1971. This tributary is in the clay till area. No augmentation of flow is expected below site B-1 in Baden Creek.

The tributary of Baden Creek at site B-3 has good base flow, approximately 0.25 cfs. Consideration should be given to installing staff gauges on ponds Bp-1, Bp-2, Bp-3 and Bp-4.

Alder Creek and Tributaries in the Study Area

Alder Creek at site A-1 had good base flow. Flow was measured to be 0.32 cfs on September 8, 1971, with no suspected discharge from the sewage lagoons at Tend-R-Flesh. The tributary of Alder Creek to the west of site A-1 should be inspected and if there is significant base flow, it should be gauged and documented.

The tributary of Alder Creek at site A-2 should be inspected and base flow documented. It is expected that there should be good base flow in this tributary because of its presence in a sand and gravel area.

Base flow at site A-3 which is a tributary of Alder Creek was measured to be 2.7 cfs on August 5, 1971. Base flow is high but it must be remembered that the stream is mainly draining kame gravel material. Additional streamflow measurements should be made at this site.

Site A-4 should be inspected and base flow documented. It is expected that base flow will be fair.

The existence of ponds Ap-1, Ap-2 and Ap-3, which showed on the topographic map, was not verified. They should be inspected and water levels documented.

Unnamed Tributary of the Nith River

The tributary of the Nith River at site N-1 was observed to have no flow twice in the summer of 1971. On October 14, 1971, one day after it had rained, the flow was estimated to be 2 to 5 gpm. This stream is mainly in the clay till area but the upper parts of the stream could possibly have some base flow because they border on the sand area to the northeast. Np-2 should be checked to see if there is any outflow. It is suspected that this stream only has flow for a short time after a rain.

Ponds Np-1, Np-2 and Np-3 should be inspected and water levels documented.

Hunsburger Creek Basin

At site H-1 on Hunsburger Creek, which is the location of the weir and automatic recorder, the minimum natural instantaneous flow was 3.56 cfs, minimum daily flow was 3.78 cfs and the seven-day minimum flow was 3.85 cfs for the period June 17 to September 30, 1971. Base flow below the weir to the Nith River is suspected to be approximately the same as at gauging site H-1, as the stream flows mainly through fairly impermeable material; clay till and stream alluvium (gravel, sand, silt and clay).

Spongy and Hofstetter Lakes

Hofstetter Lake is a kettle lake with an intermittent outflow to a small stream to the east of the lake. Flow has been observed at site HOF-1 at Mr. Peper's lane during the spring of 1971, but on September 30, 1971, no flow was observed at this site. Further details of conditions of Hofstetter Lake prior to the summer of 1971 are outlined in a letter by Mr. H. O. Peper of which there is a copy in Appendix C.

Accurate surface-water level measurements on Hofstetter Lake related to an arbitrary datum point were begun on May 3, 1971, and the measurements from May 3 to September 30, 1971, are recorded in Appendix B. The maximum water level was measured to be 1.49 feet on May 3, 1971, with a maximum deviation for the May to September period of 0.24 feet, which is very small. There was a gradual decline in water levels from the spring to the late summer period (see Table 2). Heavy rainfall apparently caused a rise in water level of 0.04 feet on September 5, 1971.

Table 2. Summary of Surface Water Elevations in Hofstetter Lake, 1971

Date	Total Monthly Precipitation (inches)	Surface Water Elevations in Hofstetter Lake (feet)
June 1, 1971	2.44	1.42
July 1, 1971	3.17	1.32
August 1, 1971	3.48	1.27
September 1, 1971	0.85	1.27
September 30, 1971		1.27

Spongy Lake is a kettle lake the surface of which is completely covered with organic material. It is quite possible that under the organic material there are substantial amounts of water.

Water Availability - Hunsburger Creek Basin Above Station H-1

Introduction

The Hunsburger Creek basin above the weir at site H-1 is the main area of study and has a drainage area of 5.43 square miles. The Hunsburger Creek basin above the weir has been divided into five main sub-basins as shown on Figure 5. Streamflow spot measurements were made of the outflow of each basin several times during the summer of 1971 under base flow conditions. (See Appendix A for actual measurements.) Detailed surface-water availability information is presented for each sub-basin in a subsequent section of this report.

Streamflow Analysis at Weir - Hunsburger Creek Basin

Continuous streamflow measurements at the weir site extended from June 17 to September 30, 1971. The weir performed very well and good continuous streamflow data were obtained. A hydrograph of average daily streamflow at the weir is presented in Figure 6, together with rainfall data taken in the basin at the rain-gauge site. It should be noted that there were three fairly dry periods which occurred from June 25 to July 3, July 31 to August 10, and August 31 to September 18. Rainfall for June, July, August and September at the Kitchener station was 22% below normal. Base flow was fairly constant throughout the dry periods with the normal gradual decline in streamflow, except for the period from August 31 to September 18. During this period base flow increased significantly on September 10 and September 13. This could only occur if there was an input of water to the basin on these days i.e. rainfall, or there was significantly less evaporation on these days from water surfaces and vegetation, or there had been withdrawals of ground water or surface water from the basin previously and these takings had been reduced. The increased inflow probably was caused by a significant decrease in evaporation although this matter should be studied further. A base flow recession curve has been drawn from the data for the summer of 1971, and is presented in Figure 7.

It should be noted that during the dry periods from June 17 to September 30, 1971, there were considerable natural daily fluctuations in flow most likely caused by evaporation from water surfaces and vegetation. The maximum natural daily variation in base flow during dry periods was 214 Imperial gallons per minute, or 0.57 cfs which occurred on June 19, 1971. The second-highest natural daily base flow variation was 180 Imperial gallons per minute or 0.48 cfs on July 9, 1971.

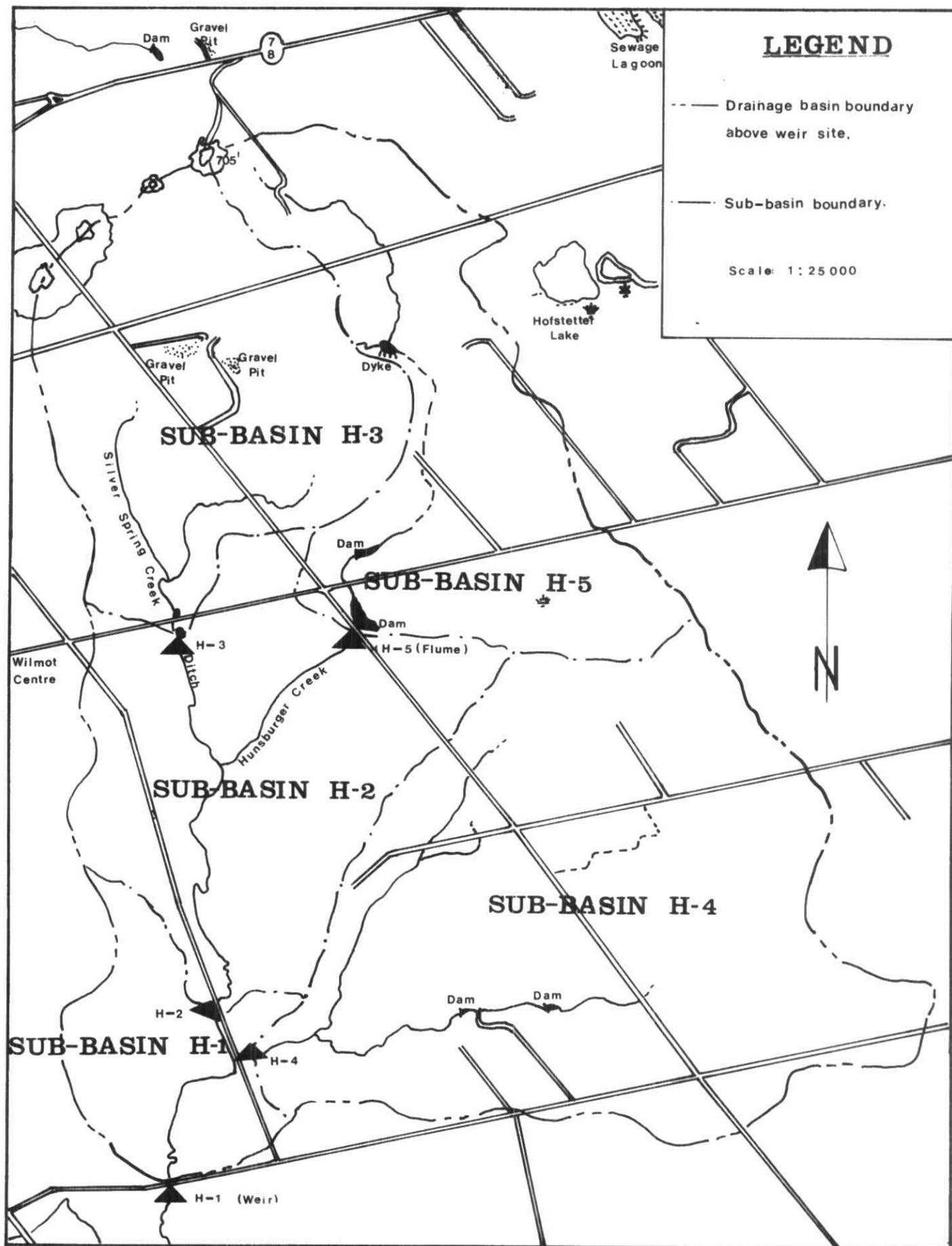


Figure 5. Sub-basins in the Hunsburger Creek basin above Station H-1.

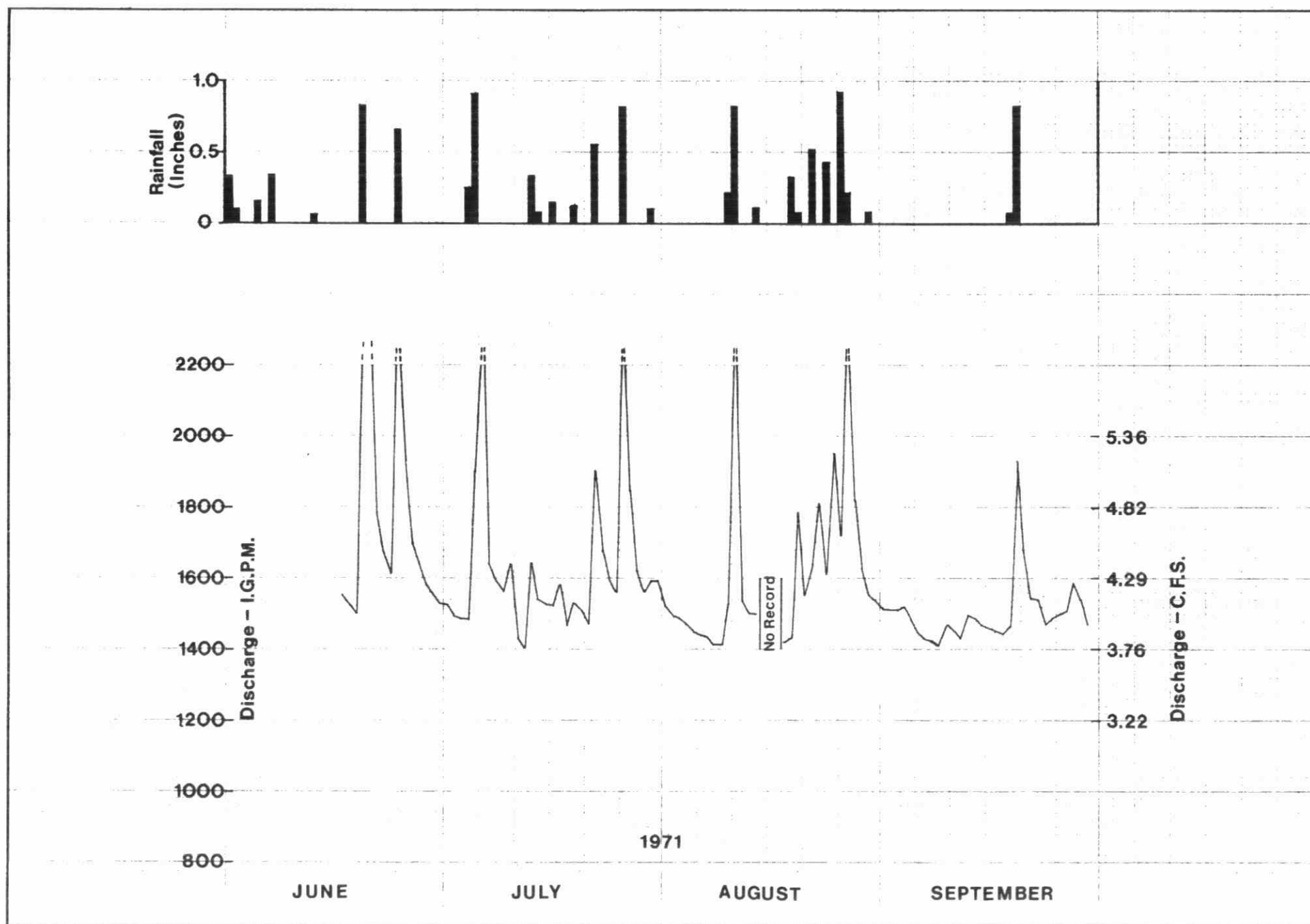
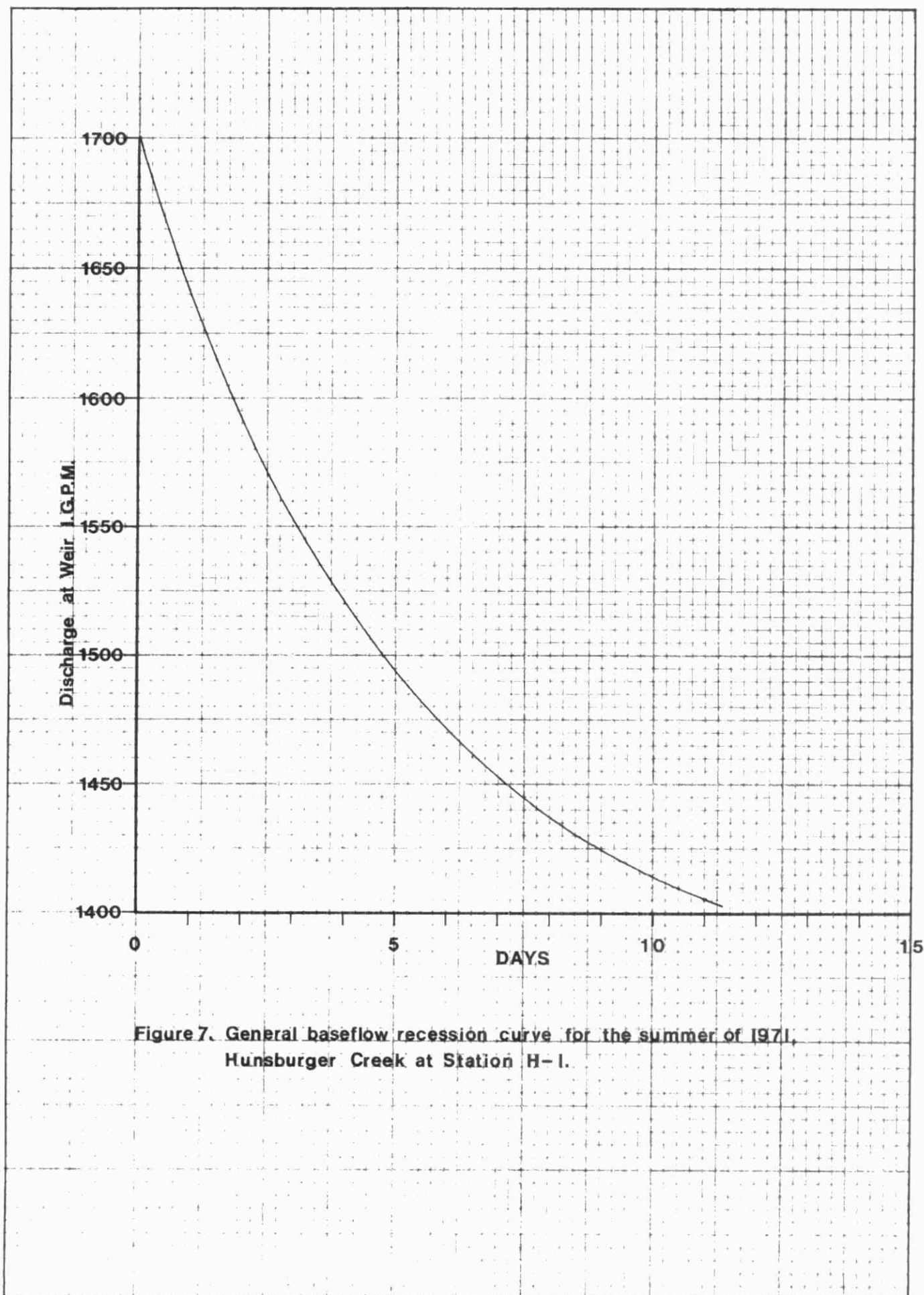


Figure 6. Streamflow hydrograph, Hunsburger Creek at station H-1.



The significant increase in flow which occurred on September 28, was probably due to someone removing one or more stoplogs from a dam. The low average daily flows for July 11 and 12, were caused by streamflow interference at one of the larger ponds in the basin.

The minimum instantaneous naturally occurring flow during the period at station H-1 was 3.56 cfs which occurred at 7:00 p.m., August 8, 1971. The minimum average daily natural flow at site H-1 was 3.78 cfs on August 8, 1971. The minimum seven-day average natural flow at the weir site was 3.85 cfs. It can be seen that base flows in the Hunsburger basin are fairly constant throughout the summer. This is evident by a difference of only 0.29 cfs or 8% between the minimum instantaneous flow and the seven-day minimum average daily flow at the weir site.

Base Flow from Each Sub-basin

Minimum instantaneous, minimum daily and seven-day minimum natural occurring flows were determined for each sub-basin of Hunsburger Creek and are presented in Table 3. The values for sub-basin H-1+ were measured by means of a weir; the others were determined by means of a flow factor which correlated spot measurements taken at each site during base flow conditions with the flow at the weir site. The flow factors presented in Table 3 represent the proportion of base flow from each sub-basin in relation to the base flow for sub-basin H-1+, taken as unity. From these flow factors an estimate of base flow in each sub-basin can be determined by simply determining the flow at H-1, the weir site. The calculated seven-day minimum flows in each sub-basin for the period June 17 to September 30, 1971, are also presented in Figure 8.

Base flows per square mile were calculated for each sub-basin of Hunsburger Creek (see Table 4). The largest flow per square mile occurred in sub-basin H-5 with a seven-day minimum flow per square mile of 1.45 cfs. The upper overburden material is mainly sand but even for a sand basin the flow per square mile is very high. The reason for this high flow is the large discharge of approximately 200 gpm from the Hofstetter flowing well (see Table 6) and the flow of approximately 100 gpm from springs under the road at sites H-5(3) and H-5(4) in front of Mr. Gastmeier's property (see Table 7).

The seven-day minimum base flow from sub-basin H-3 is 0.46 cfs per square mile. The basin is again mainly sand overburden material but the base flow per square mile is one-half that of sub-basin H-4.

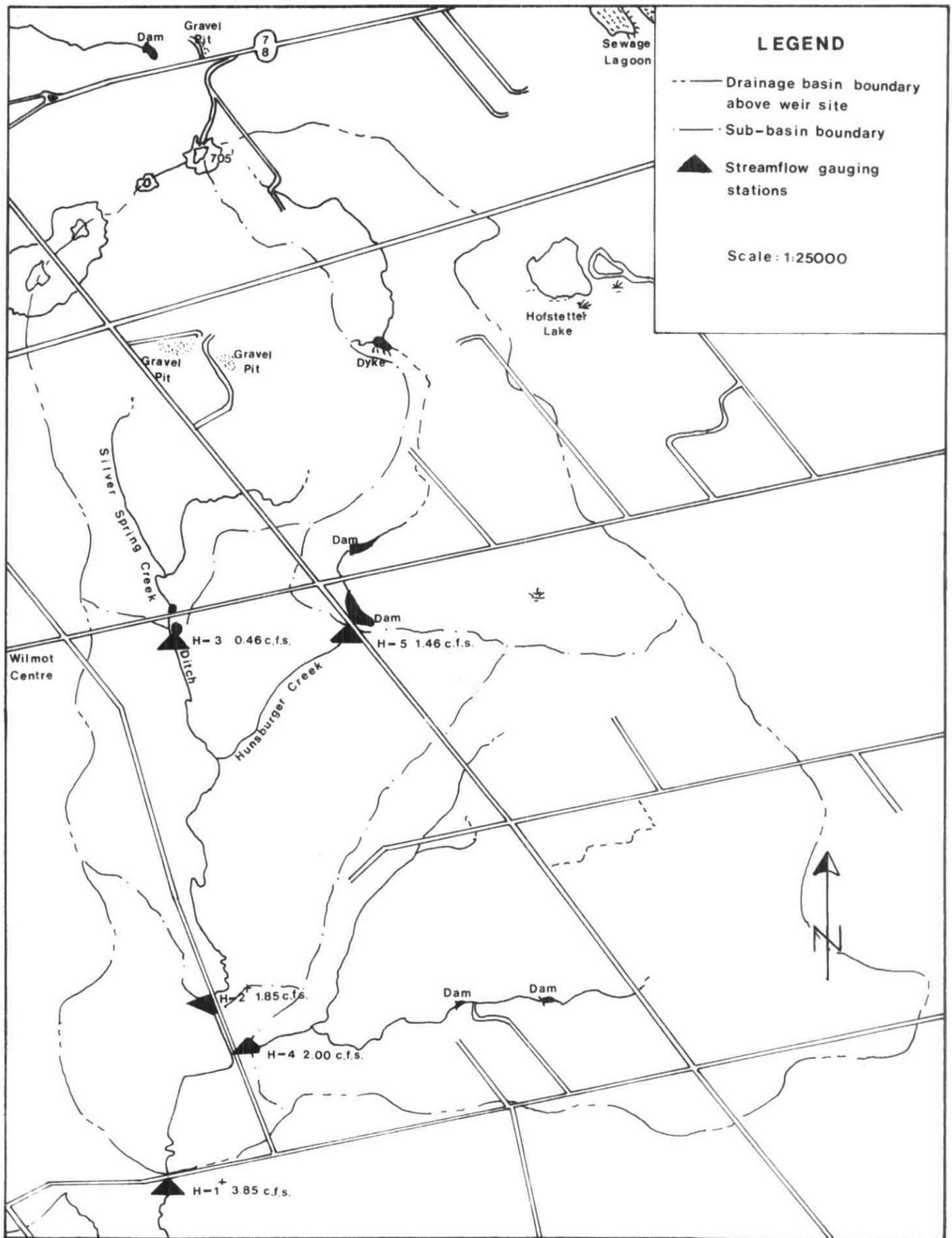


Figure 8. Seven-day minimum flows, Hunsburger Creek basin.

Table 3. Flow Factors, Areas and Natural Streamflow - Hunsburger Creek Sub-Basins

Basin	Area Drained (Sq. Mi.)	Flow Factor for Each Sub-Basin	Naturally Occurring Flows		
			Minimum Instantaneous Flow (cfs)	Minimum Daily Flow (cfs)	Minimum Seven-Day Flow (cfs)
H-1+	5.43	1.0	3.56	3.78	3.85
H-2+	3.07	0.48	1.71	1.81	1.85
H-3	1.01	0.12	0.43	0.45	0.46
H-4	1.99	0.52	1.85	1.97	2.00
H-5	1.01	0.38	1.35	1.44	1.46

Note: + designates all basins above station including the sub-basin given
e.g. H-1+ = Basins H-1, H-2, H-3, H-4 and H-5

Table 4. Streamflow in Each Sub-Basin above Station H-1

Sub-Basin	Area Drained (Sq. Mi.)	Flow Factor for Each Sub-Basin	Flow Factor Per Sq. Mi. for Each Sub-Basin	Seven-Day Minimum Flow (cfs)	Seven-Day Minimum Flow Per Sq. Mi.
H-1	0.37	0.0	0.0	0.0	0.00
H-2	1.05	- 0.02	- 0.02	- 0.07	- 0.07
H-3	1.01	0.12	0.12	0.46	0.46
H-4	1.99	0.52	0.26	2.00	1.00
H-5	1.01	0.38	0.38	1.46	1.45

The seven-day minimum flow from sub-basin H-4 is 1.0 cfs per square mile. The **upper** overburden material is all sand except for small sections of alluvial deposits along the lower parts of the streams. The natural base flow per square mile is high.

Sub-basin H-2, which has overburden material of sand in the eastern half of the basin and clay in the western half of the basin with alluvial deposits along the stream beds, appears to be slightly influent during base flow conditions. Alternatively, a combination of little or no ground-water discharge and evaporation losses could explain this condition. As can be seen from Table 3, sub-basin H-1 does not augment base flow. Basin H-1 is mainly overlain by clay till.

Diversion of Upper Hunsburger Creek

As shown in Figure 9, a stream diversion was made from sub-basin H-3 to sub-basin H-5. It is not known when this diversion was made but there is evidence to suggest that it was sometime before 1927. The water which used to flow to the tributary of Silver Spring Creek was dyked off and rerouted to flow into Hunsburger Creek. The flow was diverted into Hunsburger Creek (see Figure 9b), perhaps so that more good field area could be used for growing agricultural crops. Sometime before 1965 an infiltration ditch was constructed at the dyke (see Figure 9c). The flow from upper Hunsburger Creek now goes into the infiltration ditch. There is no flow out of the dyked area into the Hunsburger Creek channel.

Detailed Surface Water Availability in Hunsburger Creek Sub-basins

Sub-basins H-1 and H-2

Sub-basin H-1 (see Figure 10) is a small basin of 0.37 square miles which lies completely in the clay till area. There is no augmentation of base flow from this area during dry periods. The automatic recording weir is located at the mouth of this basin. The sharp-crested weir has a two-foot crest and a measurable head of 1.25 feet. Flow over the weir can be calculated from the following equation:

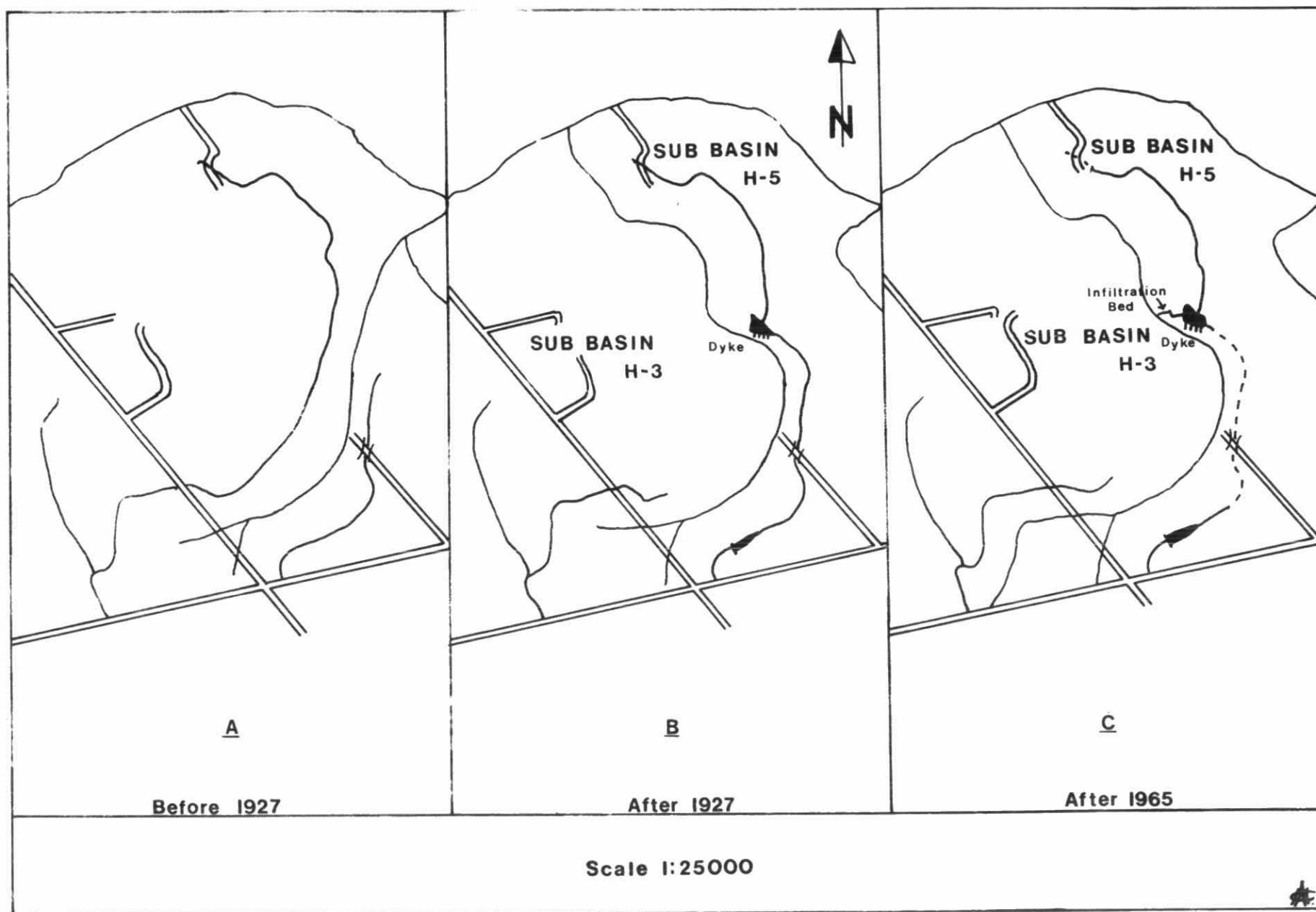


Figure 9. Location of Streamflow Diversion in Sub-Basins H-3 and H-5, Hunsbuger Creek Basin

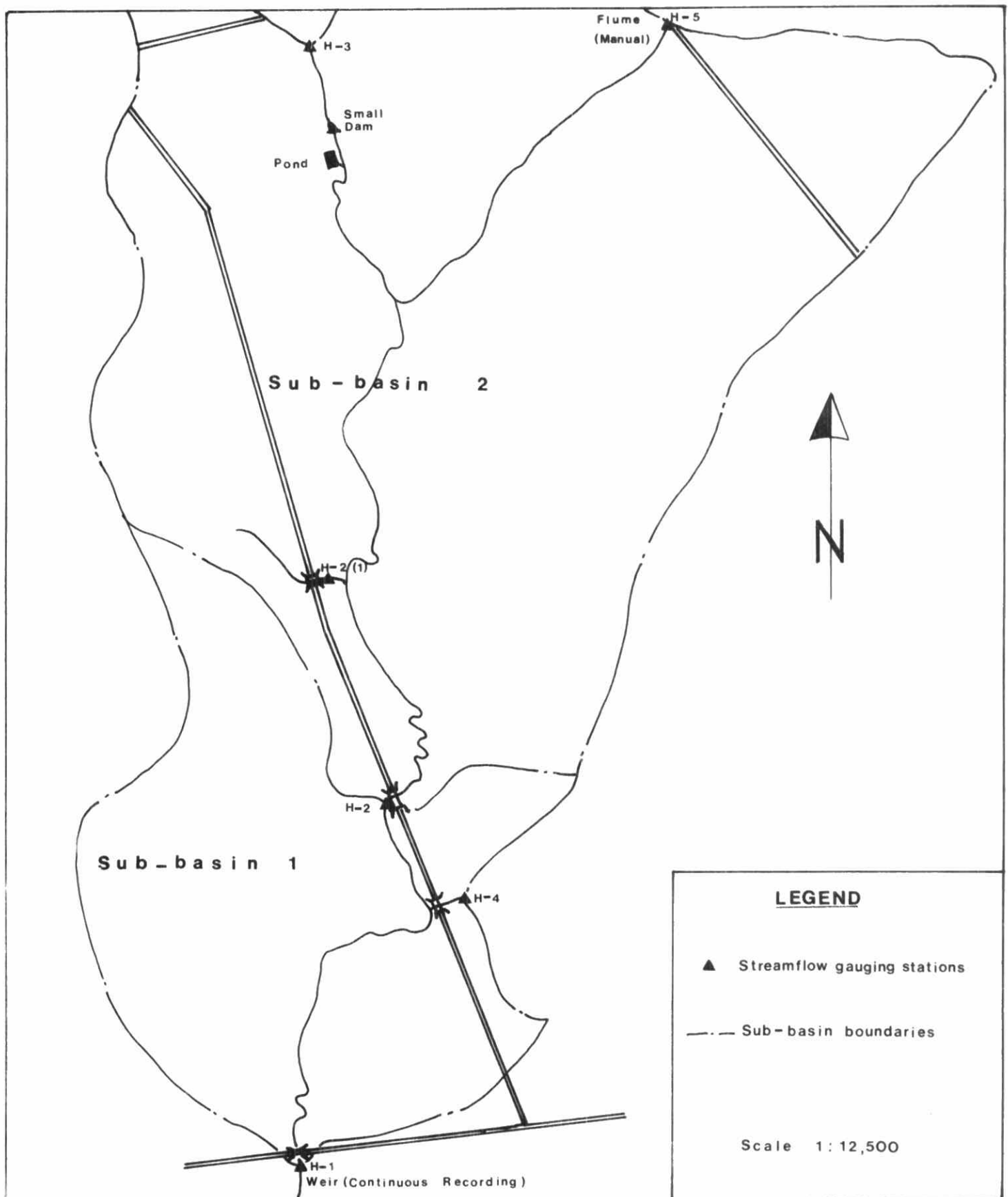


Figure 10. Detailed location map of sub-basins H-1 and H-2, Hunsburger Creek basin.

$$Q = 3.33 (L-.2H)H^{3/2}$$

where Q - is the discharge in cfs

L - is the crest length which is 2 feet

H - is the head of water acting on the weir.

The weir performed quite satisfactorily during the summer period. Flow measurements were taken by the meter method several times at the weir site and the maximum difference between the metered flow and the calculated flow over the weir was 3.1%, within the allowable error for streamgauging.

Sub-basin H-2 has an area of 1.05 square miles with the western half in the clay till area and the eastern half in the sand area. Base flow during dry periods is not augmented in this sub-basin; in fact, Hunsburger Creek may be slightly influent in this area. Alternatively, evaporation loss might explain the observed streamflow conditions.

Streamflow at site H-2(1) (see Figure 10) was measured the day after a rainfall and the flow was measured to be 1.0 Igpm but this tributary would be expected to have no flow during long dry periods in the summer.

Sub-basin H-3

Sub-basin H-3 (see Figure 11) has an area of 1.01 square miles and had a seven-day minimum flow of 0.46 cfs at gauging site H-3. The seven-day minimum flow at H-3(1) was calculated to be 0.13 cfs and at H-3(2) to be 0.17 cfs.

It should be noted that there is base flow in the ditch along the north side of the road just above gauging site H-3 which flows into Silver Spring Creek. Flow at site H-3(3) was measured to be 3.9 Igpm on October 14, 1971, the day after a rain. Although flow at this point has been observed to be much less during summer dry periods there was always some flow. It appears from the data that there is flow augmentation between sites H-3(1) and H-3(2) and gauging site H-3.

Sub-basin H-4

Sub-basin H-4 (see Figure 12) has an area of 1.99 square miles and had a seven-day minimum flow of 2.00 cfs. The base flow per square mile is 1.0 cfs which is excellent for a sand area.

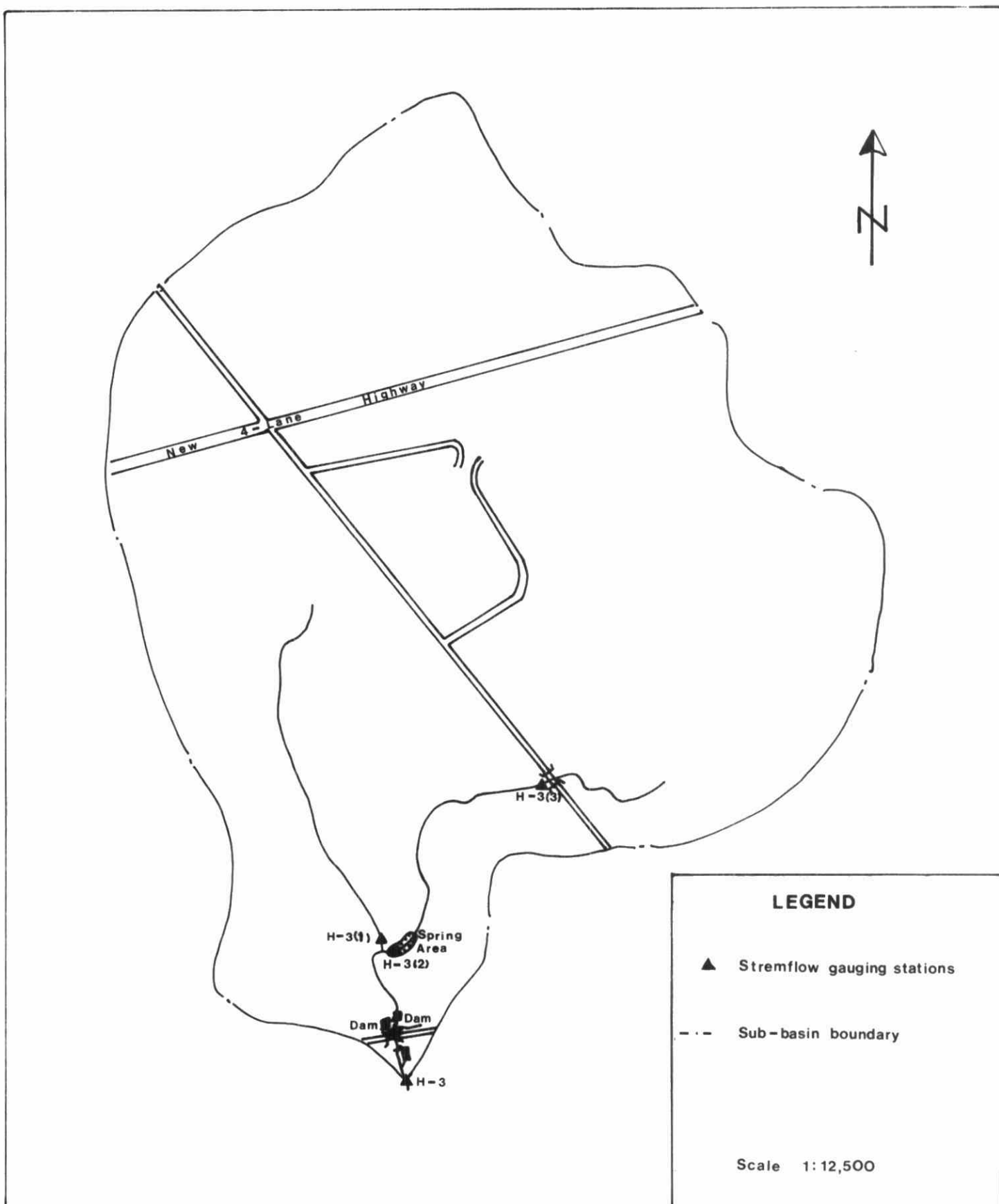


Figure 11. Detailed location map of sub-basin H-3, Hunsburger Creek basin.

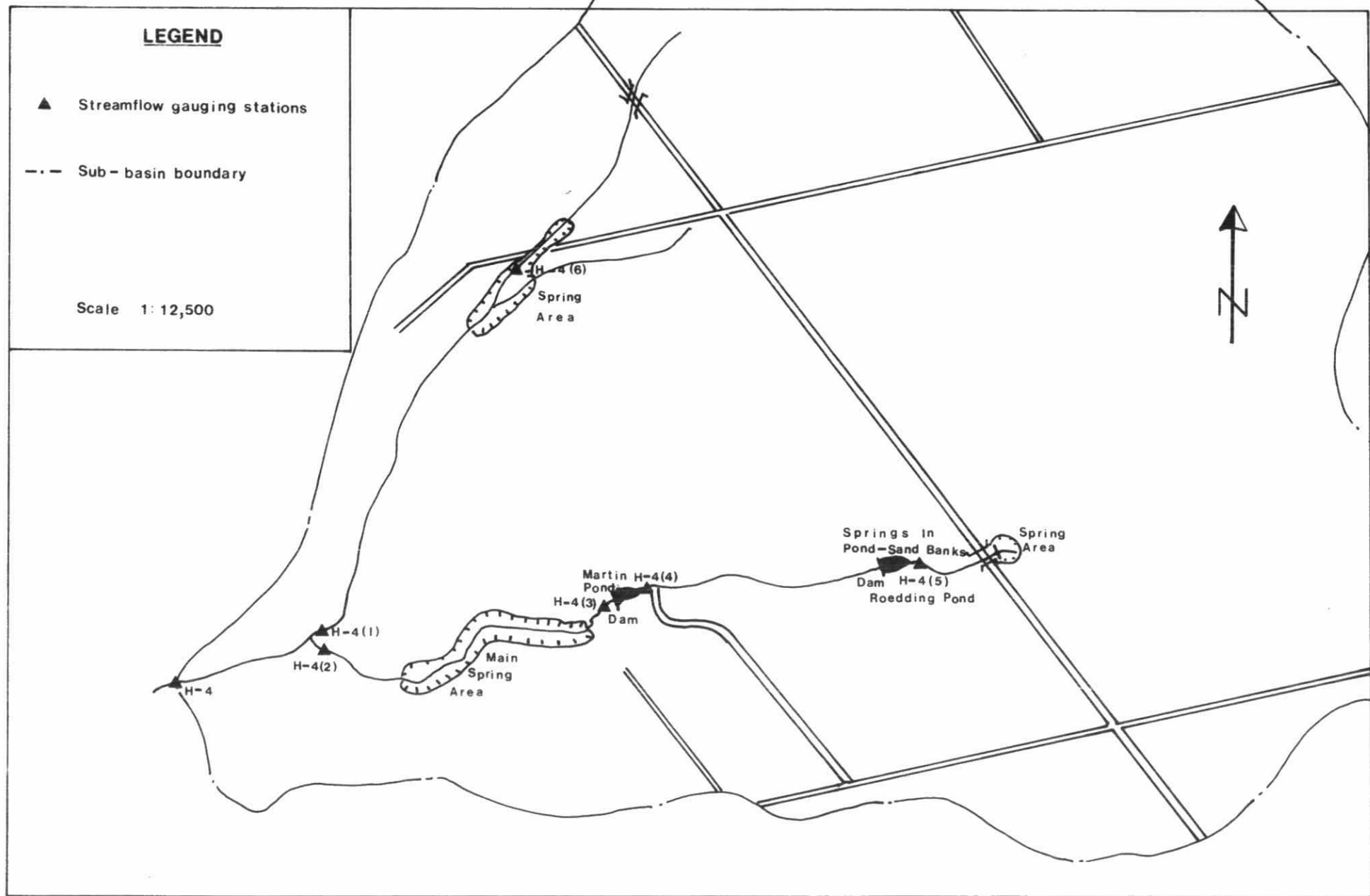


Figure 12. Detailed location map of sub-basin H-4, Hunsburger Creek basin.

The seven-day minimum flows calculated for each streamgauging site are given in Table 5. These flows were determined from one measurement at each site taken under good base flow conditions, and correlated with flow at the weir site by a ratio method.

The spring discharge areas shown in Figure 12 should be noted.

Small springs were observed in the banks of Mr. Roedding's pond below site H-4(5) when the pond was empty. When the pond is filled it is possible that these springs could cease to flow due to increase in hydraulic pressure in the pond. Inflow to Mr. Martin's pond is more than the outflow. It is possible that water is infiltrating into the ground and discharging to the stream below the dam.

Base flow north of site H-4(6) at the next road was visually estimated at 4 to 10 gpm and base flow in the tributary east of gauging site H-2(6) was visually estimated at 5 to 15 gpm.

Sub-basin H-5

Sub-basin H-5 (see Figure 13) has an area of 1.01 square miles and a seven-day minimum flow at site H-5 of 1.46 cfs. All of the 1.46 cfs measured at site H-5 is discharged from the small area outlined in Figure 14. There is a great augmentation of flow from this area, the main contributors being the Hofstetter flowing well, springs in Hunsburger Creek at the wildlife pond of Mr. Gastmeier and the spring seepage area just southeast of Mr. Gastmeier's house. It should be noted that there is no base flow in the channel leading into Mr. Gastmeier's wildlife pond.

A staff gauge should be installed and water-level measurements taken in pond Hp-1.

Hofstetter Flowing Well

Several flow measurements were made on the discharge from the Hofstetter flowing well beginning March 14, 1968, and these are recorded in Table 6. It should be noted that from the summer of 1968 to the summer of 1971, the flow from the Hofstetter well has decreased approximately 100 gpm from approximately 300 gpm to 200 gpm. Discharges from the well tended to be lower in the spring and fall than in the summer period.

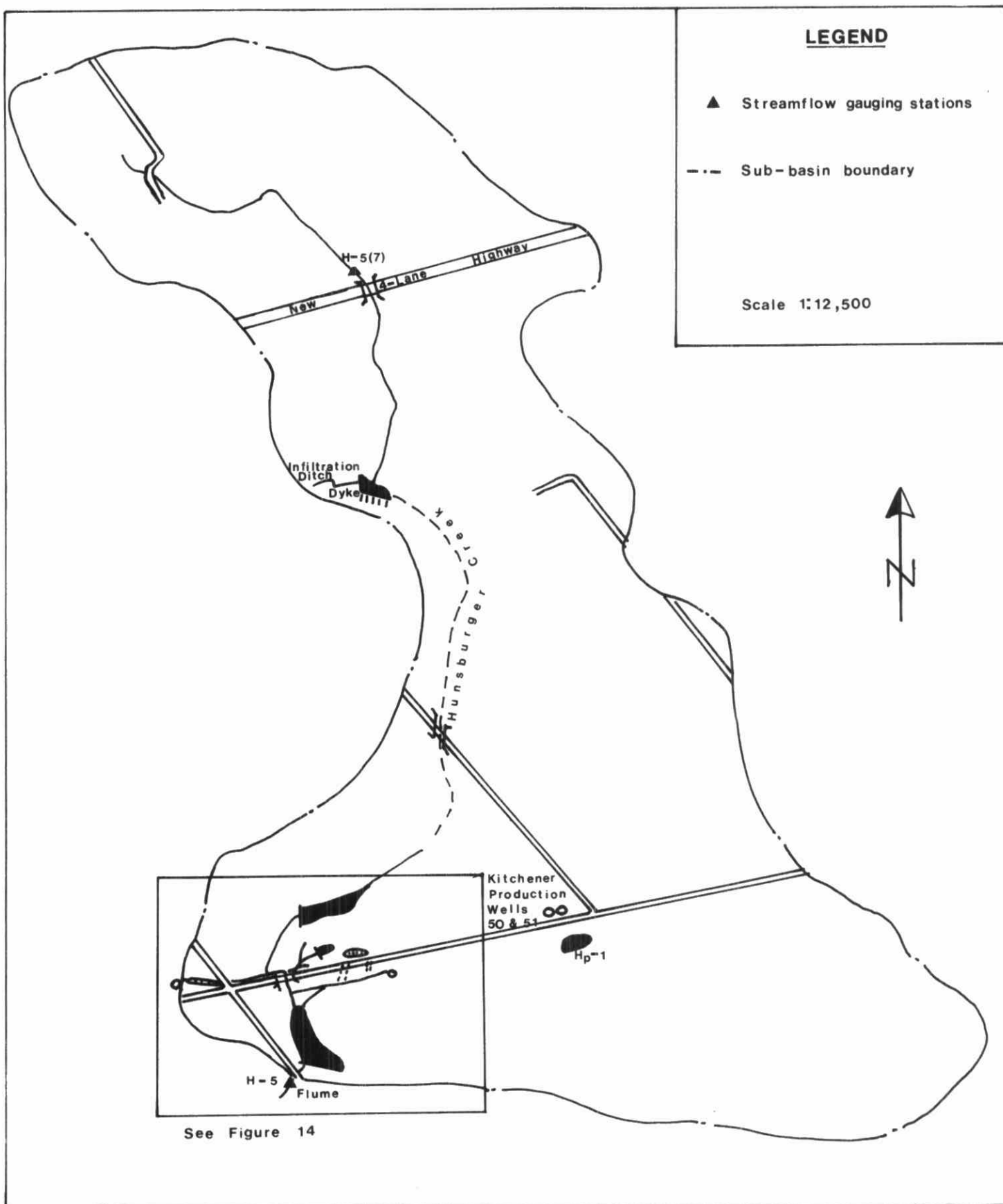


Figure 13. Detailed location map of sub-basin H-5, Hunsburger Creek basin.

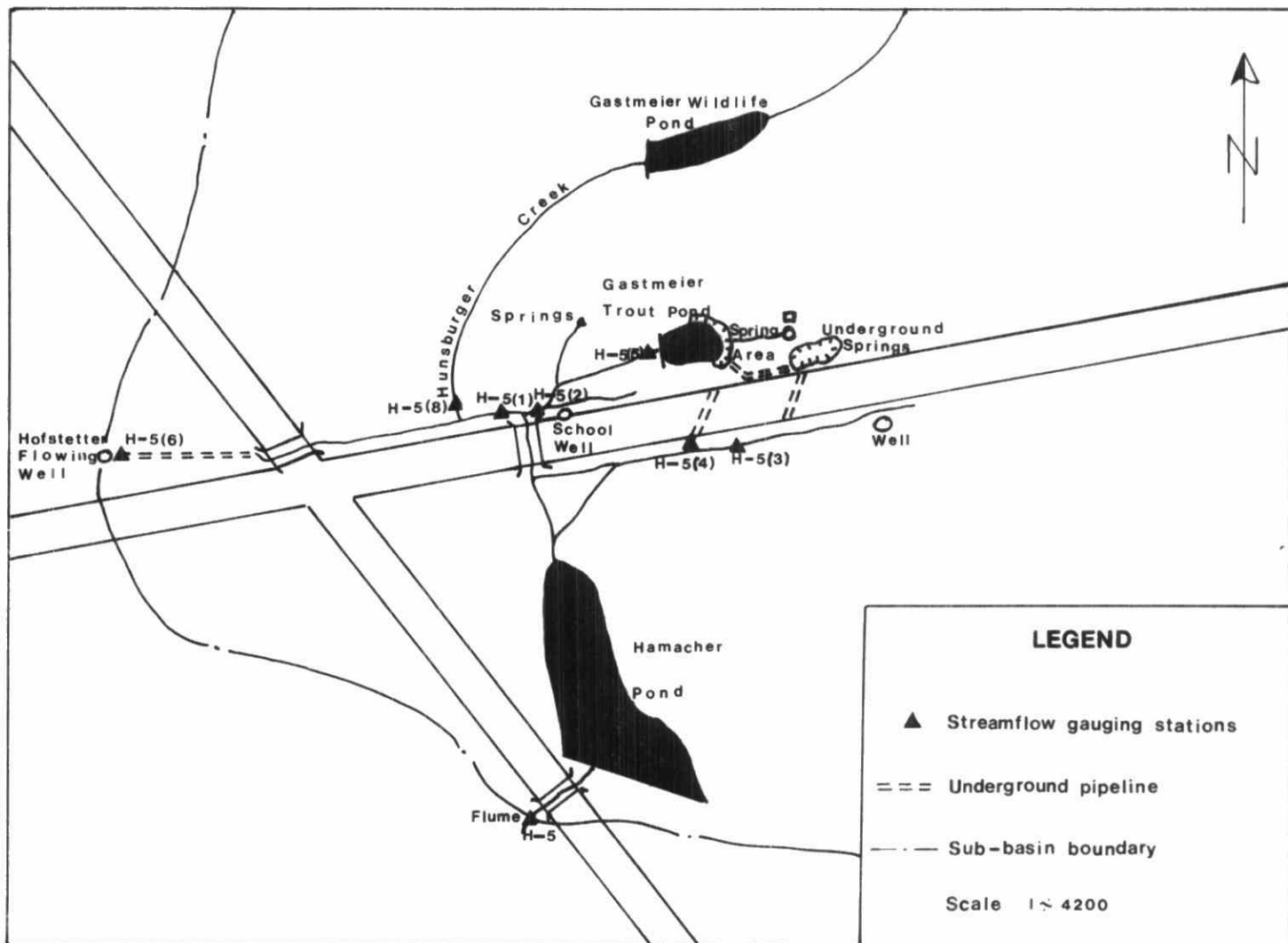


Figure 14. Detailed Location map of sub-basin 5 in the vicinity of Bleams Road.

Table 5. Seven-day Minimum Flows,
Hunsburger Creek Sub-Basin H-4

Station	Seven-Day Minimum Flow (Calculated) cfs
H-4	2.00
H-4(1)	0.75
H-4(2)	1.31
H-4(3)	0.17
H-4(4)	0.26
H-4(5)	0.06
H-4(6)	0.22

Table 6. Discharge Measurements for
Hofstetter Flowing Well

Date	Flow (Igpm)
March 14, 1968	319
April 10, 1968	293
May 10, 1968	288
June 10, 1968	314
July 10, 1968	313
November 20, 1970	239
April 21, 1971	161
May 3, 1971	135
July 5, 1971	214
July 20, 1971	218
July 21, 1971	217
July 22, 1971	217
August 4, 1971	220
August 17, 1971	208
September 9, 1971	197
September 23, 1971	192
October 6, 1971	188

Table 7. Seven-Day Minimum Flows -
Hunsburger Creek - Sub-Basin H-5

Gauging Station	Seven-Day Minimum Flow (Calculated) cfs
H-5(1)	0.69 (a)
H-5(2)	0.142
H-5(3)	0.093
H-5(4)	0.193
H-5(5)	0.034
H-5(6)	0.563 (b)
H-5(7)	0.054
H-5(8)	0.15 (a)

(a) Flows seem to decline substantially in summer

(b) Average for summer, 1971

Table 8. Instantaneous Flow Measurements -
Hunsburger Creek - Sub-Basin H-5

Date	Flow Measurements cfs		
	H-5(1) cfs	Hofstetter Flowing Well at H-5(6) cfs	H-5(8) cfs
June 10/71	0.968		.246
June 30/71	0.920		.191
Aug. 17/71	0.711	.557	.154

Spring Area at Mr. Gastmeier's Property

There is a good spring area in front of Mr. Gastmeier's property which discharges through pipes under the road to a tributary to Hunsburger Creek. The flows are presented in Table 7. According to Mr. Gastmeier, six years ago, before the road was re-constructed, the flow from these springs discharged into his trout pond.

Flow from Mr. Gastmeier's house well was measured to be 0.15 Igpm on October 6, 1971. Overflow from the school well was measured to be 8.7 Igpm on October 6, 1971.

Documentation of Streamflow in Sub-basin H-5

Flow measurements in sub-basin H-5 were taken at several locations and the seven-day minimum flows were calculated and are presented in Table 7.

It should be noted that there is base flow in upper Hunsburger Creek but this flow (21 Igpm - seven-day minimum flow) flows to the dyked area and then into the infiltration ditch. Below the dyke there is no flow in Hunsburger Creek. Flow begins again in Mr. Gastmeier's wildlife pond. There seem to be good springs in the pond although streamflow in this area declined rapidly over the summer (see Table 8). It should be noted that on September 20, 1966, a very dry year, no flow was observed at the dam and Mr. Gastmeier's wildlife pond was substantially lowered. It is evident that during long dry summer periods the springs in Mr. Gastmeier's pond may cease to flow due to natural causes.

Summary and Conclusions of the Water Availability Study

1. Base flow in Hunsburger Creek at the weir site is high with a seven-day minimum flow during the period June 17 to September 30, 1971, of 3.85 cfs and a flow per square mile of 0.71 cfs. Base flow is also steady with a difference of only 0.29 cfs between the minimum instantaneous flow and the seven-day minimum flow.
2. The sub-basin with the highest base flow per square mile of the sub-basins studied is H-5, with a seven-day minimum flow of 1.45 cfs per square mile. Approximately one-third of this flow was discharged from the Hofstetter flowing well.

3. Baden Creek has a base flow of approximately 2.4 cfs at station B-1.
4. Upper Alder Creek and its tributaries appear to have good base flow.
5. Consideration should be given to the installation of staff gauges on ponds Bp-1, Bp-2, Bp-3, Bp-4, Ap-1, Ap-2, Ap-3, Np-1, Np-2, Np-3, and Hp-1. A staff gauge should be installed immediately on pond Hp-1 and water-level measurements taken.
6. Additional streamflow measurements should be made at stations A-1, A-2, A-3, A-4, and the tributaries above these stations.
7. Consideration should be given to measuring streamflow at sites B-5 and HOF-1.
8. An automatic recorder should be installed on the flume at gauging site H-5.

WATER USE INVENTORY

Introduction

As part of the Hunsburger Creek area study an inventory of water uses was undertaken in the Hunsburger Creek and Baden Creek basins in September, 1971. (As shown in Figure 15, the boundary of the study area for the water-use inventory differs slightly from that for the water-availability study). It was decided that a complete assessment was needed of water requirements for domestic, agricultural, industrial and commercial purposes, as well as a thorough inventory of non-consumptive (aesthetic or in-place) water uses occurring in the area. In order to facilitate this, a farm-to-farm survey was undertaken.

The information requested of each household generally followed the format of the questionnaire (a sample of which is shown in Appendix D) in order to obtain specific details concerning domestic watertaking, supplies for crops and livestock, water uses for recreation and aesthetic purposes, and the source employed for these water supplies. The information obtained in this manner has been summarized in this report. In addition, the district Agricultural Representative of the Ontario Department of Agriculture and Food and the Waterloo County Health Unit were contacted to obtain information concerning the study area.

At the outset of this water-use inventory the Biology Branch of the Division of Laboratories requested that information be obtained to supplement data it would receive from the Department of Lands and Forests concerning fishery and recreational uses of streams in the study area. Therefore, landowners having recreational uses of streams and ponds were questioned concerning the occurrence of fish populations, fish kills, the use of pesticides, and the quality of water for bathing. These data, which were forwarded earlier to the Biology Branch, have been included in this report as Appendix E.

Description of the Basin

For the purposes of the water-use portion of this report, the basin description relates to the geographical and economic factors rather than to geology or physiography, as it is apparent that locational factors have, to a large measure, determined the particular land uses of the study area and consequently the water uses. The physical nature of the study area has been described previously in this report in the section on water availability.

The economy of the study area is based on intensive agriculture, as is true of the three other townships bordering Kitchener-Waterloo. The townships of Wilmot, Waterloo, Woolwich and Pilkington exhibit the highest productivity per acre of all townships in the Mid-Ontario Development area, and the highest average farm incomes of that economic region (Ontario Department of Treasury and Economics, July, 1970). In many respects the agricultural economy of the Township of Wilmot has undergone the same transition as the agricultural economy of the province in general; total farm acreage and population has declined, while total value of products sold has increased. However, the decline in acreage and farming population has been far less here than the average for the province, and the value of farm products has tended to be greater than elsewhere in Ontario.

The region has exhibited a history of mixed farming practice since it was first settled in the early 19th century. Recently there has been a decline in the growing of wheat and mixed grains in the region in favour of silage and grain corn, and the acreage of improved pasture has expanded considerably, indicating an increase in cattle and dairy production (Chapman and Putnam, 1966). There are a significant number of large poultry operations in the basin producing turkeys and broiler chickens, and a poultry slaughterhouse is located at Petersburg, near the eastern boundary of the basin.

It is reasonable to attribute this intensification of the agriculture of the area to the proximity of the urban market. The food and beverage industry is the largest in Kitchener-Waterloo, employing 16.5% of the urban labour pool. In the Midwestern Ontario Region as a whole, this same industry employs 41.6% of manufacturing labour and represents the major employer in the area, but the most relevant consideration is that almost 60% of the manufacturing inputs for this industry are obtained locally (Ontario Department of Treasury and Economics, July, 1970). Therefore, the nature of the urban industrial base has encouraged viable agricultural activity in the surrounding townships, based on supplying the food industry with livestock, dairy and poultry products, and some food-stuffs.

Land Use

From the above description it is evident that agriculture is a well established land use in the study area and is sound economically due to the proximity of the market. However, this same market is in turn creating pressures on the region in the form of urban-oriented land uses, which may eventually come into conflict with agricultural uses. A considerable number of non-farm residences have been established in the basin in recent years, and a sizable commuter population exists. The basin is quite heavily wooded and scenic, and therefore attractive for building sites. A major highway is presently under construction through the north part of the area, which will decrease the time-distance to Kitchener (making the area even more attractive to residential development) and may encourage highway commercial development and perhaps some industry.

An obvious urban pressure on the region at present is the demand for an increased water supply for Kitchener-Waterloo. The extensive aquifer west of Kitchener has been tapped for municipal supply for the past 20 years, and the aquifer underlying the Hunsburger and Baden Creek basins is now being developed. Whether the municipal taking causes serious interference or not, a water-use conflict is perceived by the residents, and this is the essence of the present opposition of certain residents of the Township of Wilmot to the activities of the Kitchener Water Commission in the area. Also as the rural non-farm population in the basin expands, recreational and aesthetic uses of the water will become more widespread, and may conflict with agricultural uses.

Water Use

General Comments

As has been indicated earlier, water use in the study area is predominantly for agricultural purposes. Industrial water use is restricted to the ground-water taking by United Co-operatives of Ontario Tend-R-Flesh poultry plant, which is located mainly within the Alder Creek watershed. Water is taken at the plant for poultry processing, and present taking amounts to 470 gallons per minute for ten hours in a day. Municipal water-taking from the Kitchener Water Commission Well No. 50 and No. 51 is proposed to commence in the near future and a well is proposed just north of the study area to serve the Police Village of Baden. Hunsburger Creek is not used to assimilate direct waste discharges.

Rural domestic use is centred on the hamlet of Wilmot Centre and the crossroads immediately east of it, and along highway 7 and 8. Streamflow is used for recreational purposes at twelve locations, including a large commercial recreation pond on the lower reaches of Hunsburger Creek. There are few other commercial water uses in the basin, and none of them are major watertakings.

Agricultural Water Use

Agriculture in the study area is given over almost exclusively to the production of cattle, dairy products, poultry and to related feed crops and pastureland. A considerable number of hogs are raised as well, both for breeding and for marketing. There was no crop irrigation in the area. An estimated 80-100 riding horses are kept.

Agricultural water use, therefore, is directly related to the number and type of livestock being watered. To aid in determining a water requirement for agriculture, a livestock inventory was undertaken. Tables 9, 10, and 11 summarize the data collected in this inventory and Figure 15 indicates the location of each livestock operation. In general terms, the following was observed:

- Several large cattle operations are located in the basin, including two beef feedlots. It was observed that the feedlot cattle were watered from deep wells rather than surface sources. Dairy cattle were pastured on more extensive areas and watered from a variety of surface water sources.
- Smaller cattle operations tended to mixed herds (beef and dairy) and utilized the most convenient source of water; wells, dugout ponds, springs, or streams.
- Swine were found in highly concentrated numbers in several hog-raising operations. Drilled wells were utilized as the source of water in all cases. On mixed farms, hogs were being raised with other livestock but in relatively few numbers.
- Poultry for meat production was found to occur exclusively in large flocks, and reliable wells were used in all operations. There were no major egg producers in the basin, and laying hens tended to be found on mixed farms, using shallow ground-water sources of water.

- In summary, the major farm operations all utilized drilled wells for watering animals and poultry; water sources on smaller farms tended to be more diverse and potentially less reliable.
- Three farms are totally reliant on springs for water supply, 21 on wells. Of the 21 wells, 4 are bored, 3 dug, 9 drilled and 5 of an undetermined type.

Table 9. Water Sources Utilized for Agricultural Purposes in the Hunsburger Creek Study Area

Wells	-	54
bored	-	7
dug	-	12
drilled	-	22
undefined	-	13
Offstream ponds-		8
Springs	-	12
Stream Sources	-	14

Table 10. Livestock and Poultry Inventory

	<u>Number</u>	<u>Farming Units</u>
Beef	2,910	20
Dairy	1,050	14
Mixed Cattle	239	10
Swine	1,160	17
Chickens	29,800	8
Turkeys	19,500	2

Table 11. Water Sources for Animal and Poultry Watering

	Wells				Dugout Ponds	Springs	Streams
	Dug	Bored	Drilled	Undefined			
Beef Cattle	3	6	10	3	4	4	5
Dairy Cattle	1	6	3	3	3	6	6
Mixed Cattle	3	3	2	3	2	3	2
Swine	1	4	8	6	2	2	-
Chickens	-	1	4	2	-	-	-
Turkeys	-	-	3	-	-	-	-

Note: One farming unit may have several sources.
There are 88 sources being used on 57 farms.

Rural Domestic Water Use

Table 12 summarizes the types of water sources being used for domestic purposes on the 57 farms in the study area.

Table 12. Farm Water Sources Utilized for Domestic Purposes

Wells	-	50
bored	- 9	
dug	- 11	
drilled	- 20	
undefined	- 10	
 Springs	-	3
 Cisterns	-	8
in use	- 1	
not used	- 7	
 Unknown Sources-		4

Forty-four farms were found to have reliable domestic water supply, 4 were reported as having inadequate supplies for the house. In one case, water from one well was shared between two farm homes. No information was available concerning 9 farm homes.

There are 76 rural non-farm homes located in the basin, and the residents of 59 of these were personally interviewed. These homes were established on lots 3 to 10 acres in size, and were found to be clustered in three areas of the basin; the hamlet of Wilmot Centre, lots 7 to 10 inclusive facing Highway 7 and 8, and lots 9 to 12, north and south of Blead's Road. It was found that all homes are served by wells, and that the ratio of drilled to shallow wells was about 40:60. As a general rule the newer homes were served by drilled wells, while the older homes relied on dug wells. Of the persons interviewed, 11 reported insufficient water supplies. Two of these considered the supply was adequate if use was limited. All insufficient sources were dug wells, and several owners were able to connect to neighbouring wells in case of emergency.

Recreational Water Use

There are 12 areas in the basin that have been identified as having water-based recreational use. (See Figure 16.) These are located mainly on or adjacent to Hunsburger Creek or its tributaries, generally in well-wooded areas. Springs are common in several of these areas.

A description of each area and the nature of its use follows. One facility is presently under construction but has been included in the inventory.

1. G. Gross - lot 14, concession SBR

An offstream dugout pond, (80' x 50' x 8'), has been constructed just east of the house and is used for swimming. The surrounding area has been improved by planting shade trees and sodding.

2. L. Hagar - lot 13, concession SSR.

Two springfed dugout ponds are located on the north slope of the Baden Hills, adjacent to an extensive woodlot. One pond is located upslope of the other, and provides water to it by overflow. The upper pond is used for swimming, but the lower pond is not used for active recreation. Outflow from the lower pond is directed by means of a drainage tile to a roadside ditch, which in turn leads to Baden Creek.

3. E. Hallman - lot 7, concession SBR (not shown on Figure 16)

A springfed, offstream dugout pond about 180' x 100' x 10' is constructed near the New Dundee Road (slightly east of the Hunsburger Creek watershed). This area is planned as a recreational facility for a proposed correction home for juveniles.

4. R. Hamacher - lot 14, concession NBR

A fish pond 80' x 45' x 6' is located north of Bleams Road, on a tributary to Hunsburger Creek. The pond is springfed and well shaded, and stocked with Rainbow Trout.

5. W. Hamacher - lot 12, concession SBR

This is an onstream pond, 200' x 120' x 10' used both for swimming and fishing. The pond is also recharged by a flowing well. The grounds are sodded and landscaped.

6. Mr. Gastmeier - lot 12, concession NBR

Two ponds formed by damming are located directly upstream of the W. Hamacher property on Hunsburger Creek. The ponds are located in a large cedar grove. The downstream pond has bank improvements to provide a swimming area, and is stocked with trout. The upstream pond is maintained as a wildlife preserve. The ponds are largely recharged by spring seepage, as streamflow upstream from the Gastmeier property was absent at the time of the investigation.

7. A. Martin - lot 14, concession 1, Block A

Mr. Martin has two small onstream ponds on a tributary to Hunsburger Creek, located in a well-managed, landscaped area. The area is a commercial operation, with picnic facilities and a barn converted for dances. The ponds are too shallow for swimming, but could be used for wading.

8. R. Battler - lot 11, concession SBR

This is an offstream, dugout pond 100' x 80' x 8', adjacent to the house on this small holding. It is used for swimming and as a source of water for fire protection. It should be noted that the water level was reported to drop about 1 foot each summer.

9. H. Peper - lot 9, concession NBR

The kettle pond known as Hofstetter Lake is partially owned by Mr. Peper (about 20%). The remainder of the area is owned by Mr. Hollman. The pond is between one-quarter and one-half mile in diameter and completely surrounded by bush, and is quite aesthetically pleasing. Uses include fishing, swimming and boating.

10. D. Roedding - lot 13, concession 1, Block A

A pond formed by damming on a tributary of Hunsburger Creek was under construction at this location during the investigation, and an application for Permit To Take Water into storage

was completed at the site by the owner, D. Roedding. The pond is surrounded by bush and the area is heavily wooded, and a number of strong springs and streamflow of about 100 gallons per minute were evident at the pond site. Mr. Roedding intends to use the pond for swimming and to stock it for fishing. The property is located upstream of the Martin property.

11. Wilmot Rod and Gun Club - lot 14, concession SBR

This private club has a dugout pond connected to Silver Creek on its property which is used for swimming and gun sports. The pond is approximately 80' x 45' x 7' and has an earthfill dam at one end to capture runoff. The pond area is kept in a natural state.

12. Holiday Beach Resort - lot 19, concession 2, Block A

This is a commercial recreation area with a man-made lake about 3/4 mile long formed by an earth-fill dam on Hunsburger Creek. Water taking into storage is authorized by Permit To Take Water. The area is occupied during the summer by campers who use the pond for swimming and boating, but the grounds have been posted by the owner to advise the campers that the water may be unsafe. The bacteriological quality of the recreation pond has been monitored by the Waterloo County Health Unit since 1969, and coliform counts have generally been within the limits for bathing. On one day (June 28, 1971), the coliform count was in excess of that considered safe for bathing under Ontario Water Resources Commission guidelines for water quality (OWRC, June, 1970). Appendix F lists the results of bacteriological sampling at Holiday Beach.

Summary and Conclusions of the Water Use Inventory

On the basis of the inventory presented in this report, a total water requirement for consumptive uses in the basin can be estimated.

For domestic purposes:

There are 133 households in the basin, 57 farm homes and 76 small holdings. Assuming 4 residents per household, and a water consumption of about 50 gallons per person per day, total daily water requirement would be 26,000 gallons per day.

For agricultural purposes:

<u>Livestock</u>	<u>Total water requirement</u> ¹
beef	34,920 gallons per day
dairy	31,500 gallons per day
mixed cattle	4,780 gallons per day
horses	1,200 gallons per day
swine	1,740 gallons per day
chickens	1,490 gallons per day
turkeys	<u>1,950 gallons per day</u>
Total	77,580 gallons per day

1. Estimates of water requirements are based on Ontario Department of Agriculture and Food criteria.

These figures are meaningless without considering the adequacy of supply in the evaluation. In the case of supplies for agricultural purposes, the major operations have deep well systems that should remain adequate unless well interference is severe. Therefore, the bulk of the livestock are served by the most reliable sources. There are many water sources being used on a seasonal basis or as an auxiliary supply, and the majority of farms have more than one source of water for agricultural uses. However, ten farms are totally reliant on shallow wells or springs for water.

As many as 30 homes are using shallow wells as the sole domestic supply, and 11 of these wells have proven seasonally unreliable in the past.

There are 12 properties within the study area that have water-based recreational uses. Of these 12, seven utilize onstream ponds as a source of water while four properties have offstream-pond facilities developed for recreational purposes. One property fronts on a natural kettle lake.

It is evident that springs make an important contribution to the water supply of both onstream and offstream ponds; three of the four offstream ponds are recharged by springs, and three of the six stream-fed ponds are supplemented by spring discharge. On one property, a stream-fed pond is also fed by discharge from a flowing well.

BIOLOGICAL STUDY OF HUNSBURGER CREEK

Introduction

This section of the report summarizes the results of the biological study of Hunsburger Creek based on data collected from June to September 1971, by the Biology Branch.

Methods

Bottom Fauna

At each of three stations indicated on Figure 17, macroinvertebrates associated with the creek bottom were collected in June, July and September. For a quantitative estimate of numbers, a square foot of substrate was sampled using a Surber Sampler. Also for a more complete qualitative estimate, hand-seives were used to sample a variety of aquatic niches at each station. Organisms were preserved in ethanol and returned to the London Laboratory where they were identified.

Fish

In June and July, electroseining techniques were used to obtain a rough estimate of types of fish present at stations 2 and 3. Owing to the small size of the stream of station 1 and its proximity to site 2, no sampling was conducted at 1. In June, a 300-foot section of stream was blocked off by seine nets and electroseined three times to obtain a quantitative estimate of the fish population. Most fish were identified in the field and returned to the creek although a few of the specimens which were difficult to identify were preserved and returned to the laboratory for accurate identification. Fish were sampled only qualitatively in July.

Physical-Chemical Characteristics

Observations on water temperature, clarity and other obvious physical characteristics were made during each biological sampling run. Field personnel from the Division of Water Resources aided in the collection of water samples and temperature information. A total of eight collections of water samples were made during June through September.

On July 19 and 20, dissolved oxygen concentrations were determined at each station at six four-hour intervals. Water temperature data complemented these determinations.

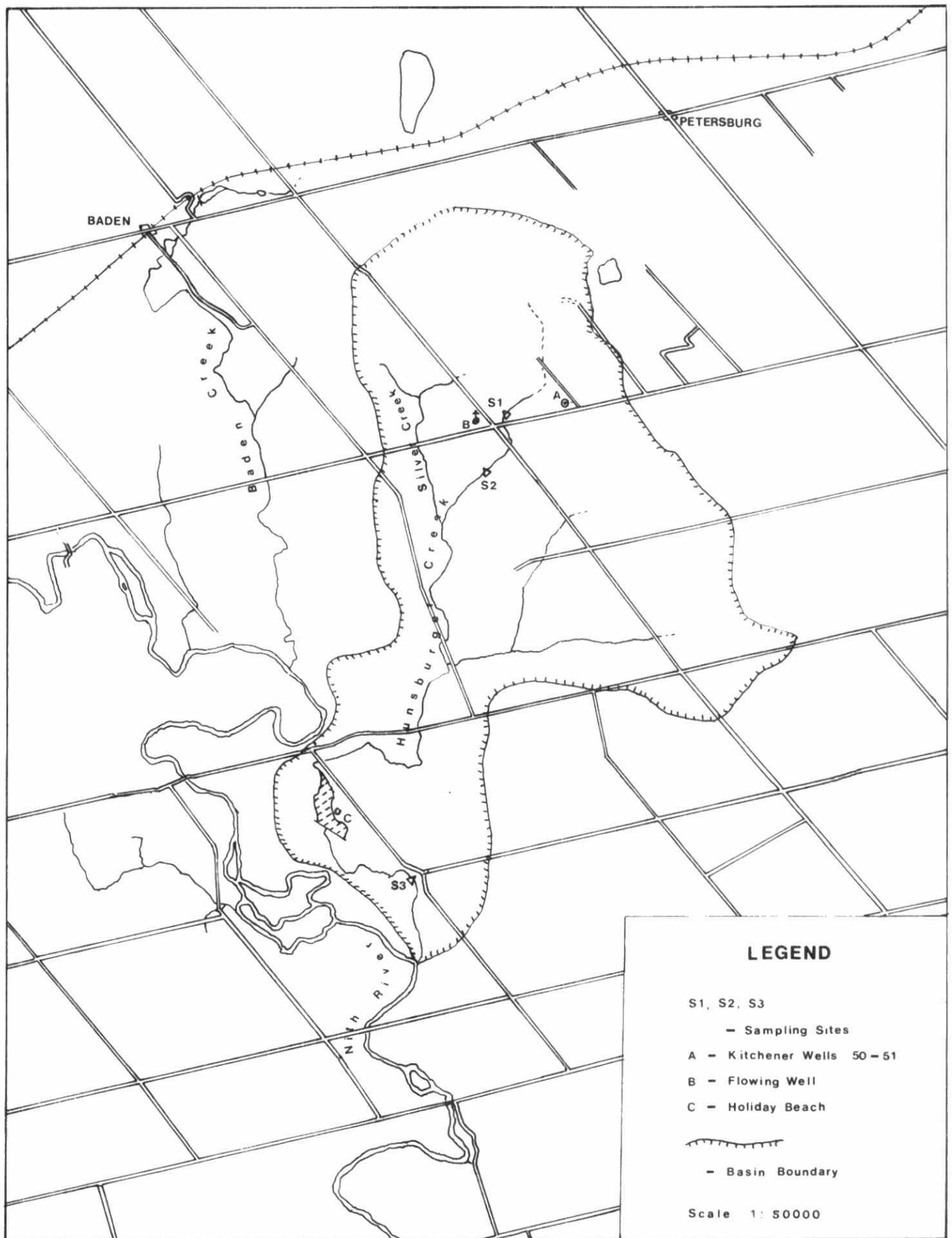


Fig. 17; Location of biological study, Hunsburger Creek

Results

Bottom Fauna

Numbers and types of benthic organisms collected at each station during June, July and September may be found in Appendix G.

A total of 43 different macroinvertebrate taxa were found at the three sampling sites. The benthic association at all stations was typical of unpolluted water although organisms usually found in rapid-flowing cool streams were limited to the two uppermost stations. At each station throughout the year the benthic population was well established indicating a permanent flow from June through September.

Each station was unique in its variety of organisms and in seasonal variation of total numbers. Station 1 was represented by a total of 26 different taxa throughout the year, most of which (Stoneflies, Baetis, Limnephilus, Simuliidae) preferred appreciable current and cooler water temperatures. Total numbers of organisms increased from 16 per square foot in June to 281 per square foot in September. Nineteen different taxa were found at station 2 and once again, swift and cold-water forms (Stoneflies, Chimarra, Rhyacophila, Sortosa, Corydalidae) were common. Numbers per square foot decreased from 150 in June to 35 in September. Forms associated with cooler more rapid waters were rare at station 3 where 24 different taxa were found. Taxa such as Cheumatopsyche, Hydropsyche, Physa, Helisoma - typical of warmer southwestern Ontario streams - dominated the population which attained a density of roughly 150 organisms per square foot during July and August.

Fish

An inventory of types and numbers of fish collected at stations 2 and 3 in June and July is presented in Appendix H.

A total of 18 different taxa were found at stations 2 and 3 although the variety found at each station differed greatly. Brook trout and cold-water forms often associated with trout waters (redbelly dace, blacknose dace, sculpins and ammocoetes of the American brook lamprey) were limited to the upper reaches of the creek. Warm-water species more widely distributed throughout southwestern Ontario were found at station 3. Approximately 100 individuals were fished from 300 feet of stream at station 2 while 50 were caught at station 3.

A single rainbow trout observed at station 1 in September most likely originated from a pond of one of six landowners in the basin who has constructed improved trout ponds.

Department of Lands and Forests officials reported that a natural brown-trout population was practically eliminated as a result of a fish kill in 1965.

Physical-Chemical Characteristics

Results of chemical determinations on 8 water samples collected at stations 1, 2 and 3 during the period from June through September are indicated in Table 13. Water temperature data are also included.

In general, water at stations 1 and 2 was clear and aquatic weed growth was sparse. It was noted during June and July that the water at station 3 was turbid and periphyton growth was common. In September, water was clear at station 3 although periphyton growth covered roughly 80% of the riffle area. Water temperatures increased from an average of 11°C at station 1 to 16°C at station 2 and 22°C at 3. Ponds between stations 1 and 2 were likely responsible for the temperature increase at site 2. Extensive unshaded areas of the creek as it ran through agricultural land and the Holiday Beach recreation pond were responsible for the additional increase in average temperatures at station 3.

Average concentrations of most chemical parameters increased with progress downstream but water appeared to be of good chemical quality at each sampling site. Most outstanding were increases in average levels in inorganic nitrogen at station 3 (2.06 ppm) which exceeded concentrations at station 2 by a factor of ten. Since soluble phosphorus levels remained relatively constant from station 1 through station 3, the high nitrogen level was at least partially responsible for the abundant periphyton growth at station 3 in September.

Averages and ranges of dissolved oxygen concentrations at each station during a 24-hour period on July 19 and 20 are indicated in Table 14. Figure 18 shows the diurnal oxygen curve for each station on the same date.

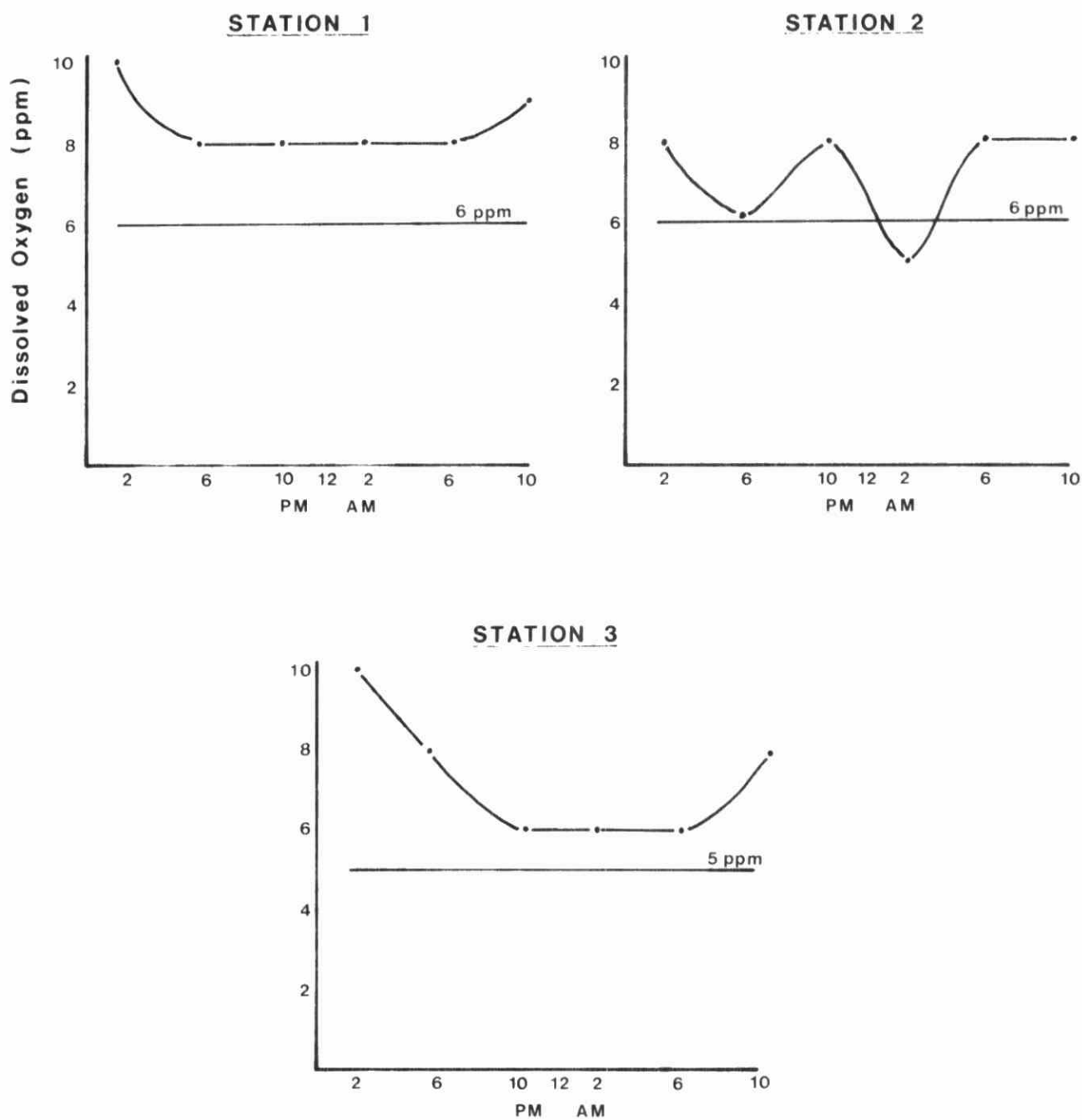


Figure 18: Diurnal oxygen curves for three sampling sites on Hunsburger Creek, July 19-20, 1971.

Table 13. Average Concentrations and Range of Chemical Parameters at Three Sampling Locations on Hunsburger Creek. (Average of eight collections from June through September, 1971.)

PARAMETER (ppm)	STATION					
	1		2		3	
	Avg.	Range	Avg.	Range	Avg.	Range
B.O.D.	.7	(.4-1.0)	1.9	(.4-2.4)	3.6	(2.4-7.0)
Solids - Total	324	(310-350)	333	(300-480)	300	(250-340)
Suspended	9	(5 - 15)	13	(5 - 30)	19	(10 - 25)
Nitrogen Kjeldahl	.23	(.12-.30)	.31	(.10-.44)	.64	(.26-.94)
(as N) Ammonia	.08	(.01-.17)	.04	(.01-.11)	.05	(.01-.16)
Nitrite	.023	(.004-.076)	.009	(.003-.028)	.052	(.034-.074)
Nitrate	.20	(.15-.27)	.16	(.01-.28)	1.96	(.18-2.50)
Phosphorus - Total	.027	(.013-.052)	.046	(.028-.11)	.085	(.020-.24)
(as P) Soluble	.009	(.005-.017)	.004	(.001-.009)	.006	(.001-.019)
Conductivity ($\mu\text{mhos}/\text{cm}^3$)	496	(484-506)	476	(463-485)	415	(377-439)
Alkalinity	231	(215-239)	223	(208-323)	179	(150-238)
Chlorides	6	(4 - 8)	6	(4 - 8)	9	(6 - 10)
Turbidity Units*	2.8	(1 - 6)	6.3	(1 - 15)	8.3	(1.5-15)
pH at Lab	7.8	(7.4-8.1)	8.0	(7.6-8.1)	8.1	(7.5-8.4)
Temperature ($^{\circ}\text{C}$)*	11	(8 - 14)	16	(10 - 20)	22	(16 - 26)

* 1 reading each month

Table 14. Average and Range of Dissolved Oxygen Concentrations at Three Stations on Hunsburger Creek, Determined at Each Station at Six Four-Hour Intervals. (July 19-20, 1971).

Station	Dissolved Oxygen					
	Average		Maximum		Minimum	
	ppm	% sat'n	ppm	% sat'n	ppm	% sat'n
1	8.5	(76%)	10	(93%)	8	(69%)
2	7.2	(73%)	8	(86%)	5	(50%)
3	7.3	(80%)	10	(117%)	6	(63%)

At station 1, little variation occurred in concentrations of dissolved oxygen on a 24-hour basis with levels ranging between 8 and 10 ppm. At station 2, however, concentrations were variable ranging from 8 ppm during daylight hours to 5 ppm for a short period in early morning darkness. This oxygen regime barely satisfies the guideline for coldwater biota in OWRC's "Guidelines and Criteria for Water Quality Management in Ontario", June, 1970. During darkness at station 3, dissolved oxygen concentrations fell to 6 ppm but increased to 10 ppm during daylight. Levels of dissolved oxygen did not become critical since the 5 ppm guideline for warm-water biota applied at this location.

Summary and Conclusions of the Biological Study

The benthic association at all stations was typical of unpolluted water although organisms usually found in trout streams were limited to stations 1 and 2. Benthic populations were well established indicative of a permanent flow from June through September.

Cold-water species of fish associated with trout waters were found from station 2 upstream whereas warm-water species more commonly found in southwestern Ontario dominated the fish population at station 3.

Water clarity declined noticeably at station 3 and aquatic vegetation growth increased significantly. Average water temperatures doubled from 11°C at station 1 to 22°C at station 3.

Concentrations of most chemical parameters increased with progress downstream but generally, water remained of good chemical quality throughout. Diurnal levels of dissolved oxygen decreased to marginal levels at station 2 during darkness. Variation between maximum and minimum concentrations of dissolved oxygen during a 24-hour period increased with progress downstream.

A reduction of flow in the upper reaches of Hunsburger Creek would have significant effects on naturally-occurring cold-water biota. The construction of ponds, clearing stream banks of vegetation cover and the natural decrease in flow rate in the lower reaches of the stream have resulted in a doubling of average water temperatures from station 1 to 3. A reduction in flow would warm the stream further, jeopardizing cold-water species at stations 1 and 2. The National Technical Advisory Committee of the U.S. Federal Water Pollution Control Administration recommends a maximum temperature of 68°F (20°C) for satisfactory growth of trout. At present, stations 1 and 2 are well within this guideline. Oxygen concentrations at station 2 were marginal for cold-water biota in mid-July and reduced flows would depress these levels even further.

OUTLINE OF OWRC POLICY CONCERNING WATER SUPPLY INTERFERENCE

Introduction

Existing policies which have been established by the OWRC with respect to water-supply interference problems are outlined below and are related to the conditions in the basin as previously described in this report.

The basic philosophy of the permit program is to provide control of surface-and ground-water use in Ontario, while allowing efficient development and reasonable and beneficial use of the resource. In applying this philosophy to the proposed taking by the Kitchener Water Commission, the objective is to authorize withdrawals from Well No. 50 and No. 51 and to provide reasonable protection to existing uses of water and the natural environment.

Existing uses of water which may be interfered with in this area are summarized in Table 15.

Table 15. Types of Anticipated Water Supply Interference
Classified by Source and Use.

<u>Source</u>	<u>Use</u>
Wells	(a) domestic and farm (b) pond recharge
Streams	(a) stock-watering (b) natural functions: cold-water biota (upstream); warm-water biota (downstream)
Ponds: on-stream and off- stream	recreational and aesthetic; fire protection
Lakes ¹	recreational and aesthetic; fire protection; natural functions

¹ For the purposes of this report, naturally-occurring water bodies are referred to as lakes to distinguish them from man-made ponds.

Although there are a variety of factors which must be taken into account when a conflict arises among parties who take water for a number of different uses, three considerations are basic to the assessment of water-supply interference problems:

- (1) priority of use
- (2) priority of time
- (3) adequacy of the affected supply
prior to interference

Priority of use requires an evaluation of the relative priority of the various uses. The use of water for private, domestic and farm purposes is considered the most important use, followed in most cases by the use of water for municipal purposes. The taking of water for industrial, commercial and irrigation purposes is regulated on the basis of availability of the supply, efficiency of use, and established uses of water in a particular locality. The preservation of sufficient surface water and its regulation for pollution control, flood control, fire protection, recreation, and wildlife preservation are also important factors which must be considered when dealing with the use of water.

In cases of ground-water interference, priority of time and adequacy of a water supply prior to interference are also basic considerations. These two factors taken together mean that in general, if a taking of water from a well causes serious interference with other water supplies obtained from an adequate source that was in use prior to the time that the permit was issued for the well, the party causing the problem is required to restore the affected supply in a manner satisfactory to the OWRC, or to reduce the rate and amount of taking so that serious interference is eliminated.

Each of these considerations is dealt with in greater detail in the following discussion of interference problems classified by source.

Wells

In cases where a previously adequate well-water supply (other than a flowing well) is seriously affected, the party causing the problem is required to restore the supply in a manner

satisfactory to the OWRC. This may include either paying for the cost of:

- (a) modifying the pumping equipment;
- (b) deepening the well or drilling a new well;
- (c) connecting to the municipal supply with the affected party purchasing water at the prevailing rate;

or reducing the rate and amount of taking until serious interference is eliminated.

The free flow of wells is not protected. This policy was established because a requirement to maintain the free flow of wells would prevent the efficient development of significant supplies of ground water. The alternative of developing as much water as possible from an aquifer within the limits of its perennial recharge is recognized as good water-management practice. It allows for the maximum use of a renewable resource for beneficial uses for as many people as possible.

Restoration of a water supply from a flowing well is required, provided the affected party can demonstrate that:

- (a) an adequate water supply for an existing beneficial use is obtainable by means of a pump installed in the affected well; and
- (b) a sufficient lowering of the water level in the well occurs due to interference to prevent the withdrawals of an adequate amount of water by means of the pump to meet normal requirements.

An improved spring used as a source of supply is treated as a well. It shall be deepened if the supply is interfered with to the point where sufficient water cannot be pumped from it. The owner is expected to provide a pump. An unimproved spring is not treated as a well.

Certain private well-water supplies were interrupted as a result of the taking of water from Well No. 50 during the pumping test in April and May, 1970. Temporary or permanent restoration of these supplies was provided by the Kitchener Water Commission at that time. Prior to the start of production pumping, the Kitchener Water Commission should be required to restore all private well-water supplies seriously interfered with during the pumping test in accordance with the policy outlined above.

Streams

In cases where the taking of water interferes with streamflow, sufficient flow must be maintained to meet the needs of existing users of water and the existing natural functions of the stream.

The data presently available indicate that streamflow in Hunsburger Creek will be affected in the vicinity of Bleams Road. Although detailed, accurate information is not available, the consulting hydrologist retained by the Kitchener Water Commission estimated that the streamflow reduction at the end of the pumping test in May, 1970, at the site designated as station H-5 on Figure 5 was approximately 200 gallons per minute. Streamflow at station H-5 is presently augmented by the discharge of two flowing wells, which will not be protected for the reasons outlined above.

The headwaters of Hunsburger Creek presently support cold-water biota. As pointed out previously, the Biology Branch has indicated that a reduction of streamflow could have a significant effect on cold-water biota. The biological report also indicated that the headwaters supported cold-water biota in 1965, prior to the construction of the two flowing wells. Although it cannot be determined with certainty that the stream currently could support cold-water biota without the flow from the flowing wells, it is not considered reasonable to require the municipality to augment the natural streamflow to compensate for possible degradation of stream conditions resulting from the activities of riparian property owners, such as the construction of on-stream ponds which generally render stream conditions less favourable for cold-water biota.

Accordingly, the following formula was used to calculate the minimum streamflow which could be maintained at station H-5:

$$\text{minimum flow requirement} = \text{flow at station H-5 minus} \\ \text{flow from the two flowing} \\ \text{wells.}$$

This formula was applied to two sets of data obtained in 1971:

- (a) the 7-day minimum average streamflow at station H-5 and the average flow from the two wells;

- (b) flow at station H-5 and from the two wells at a given point in time (1:30 p.m., July 31, 1971).

The minimum flow requirement was calculated to be 335 and 340 Imperial gallons per minute, respectively. In view of the limits of accuracy of streamflow measurements, it is felt that a minimum flow of 350 Imperial gallons per minute should be maintained at station H-5. Stream conditions should be studied following the commencement of production pumping so that the minimum flow requirement can be re-assessed and revised if necessary.

The interference, if any, which will occur with streamflow at other locations in the basin cannot be determined at this time. However, the Kitchener Water Commission would be responsible for maintaining a specified minimum flow at other selected locations if serious interference occurs.

Onstream Ponds

The water level in on-stream ponds will be maintained as a by-product of maintaining streamflow. It is felt that the most efficient method of maintaining streamflow and pond levels in the vicinity of Bleams Road will be to discharge water from Well No. 50 and No. 51 into Mr. Gastmeier's wildlife pond and to direct a portion of the outflow by means of a gravity pipe to his trout pond. The outflow will pass through Mr. Hamacher's pond via the existing stream channel before reaching the flume.

It will be necessary for the Kitchener Water Commission to either visually monitor the flume daily, or to install a device to automatically monitor flow at the flume and regulate the required rate of discharge to the stream.

It will also be necessary for the owners of on-stream ponds to operate water-level control works with care, to avoid defeating the purpose of the streamflow-maintenance requirement. The owners of these ponds should be advised by letter of the importance of this matter.

Offstream Ponds and Lakes

The problem of possible interference with the water level in off-stream ponds and lakes is the most difficult to resolve. There are two principal reasons for this difficulty.

The first is the limited observations made during the pumping test. There was not conclusive evidence that any pond or lake levels would be lowered by production pumping of Well No. 50 and No. 51. Secondly, the occurrence of interference with off-stream ponds caused by wells is so rare that a policy has not been established to deal with this possibility. These reasons identify the need for a continued monitoring program of the water levels in off-stream ponds and lakes, and for the development of a general policy concerning this type of interference which may then be applied.

SUMMARY AND CONCLUSIONS

It is recognized that the proposed water taking from Well No. 50 and No. 51 will have an effect on surface and ground water in the Hunsburger Creek area. However, it is also recognized that any human activity will result in some change in streamflow and ground-water levels. For example, the discharge of water from a flowing well or the installation of land drainage works has an effect on ground-water levels, and the storage of water in an on-stream pond increases evaporation losses and results in a reduction in downstream flow.

Based on acknowledgement that water-resource development will have an effect on natural hydrologic conditions, it is then necessary to evaluate the extent of this effect, and to offer reasonable protection to existing uses of water, based on an evaluation of current conditions in the area and the relative priority of each use.

Using this approach, it is concluded that the withdrawal of water from Well No. 50 and No. 51 by the Kitchener Water Commission can be authorized subject to appropriate terms and conditions based on established policy for the reasonable protection of existing uses of water in the Hunsburger Creek area.

Further, a policy is needed to deal with the rare but potential occurrence of interference with the water level in off-stream ponds and lakes as a result of pumping from wells.

RECOMMENDATIONS

It is recommended that a Permit To Take Water from Well No. 50 and No. 51 at a maximum combined rate of 2,100 Imperial gallons per minute be issued to the Kitchener Water Commission. The permit should contain terms and conditions which state the responsibilities of the permittee with respect to interference, based on established OWRC policies, and which require the implementation of the policy to be established to deal with interference with the water levels in off-stream ponds and lakes.

It is recommended that the monitoring of streamflow and the water levels in wells, lakes and ponds should be continued. The Kitchener Water Commission should be required to monitor streamflow and the water levels in observation wells and ponds at locations and time intervals to be specified by the OWRC, and to provide the data to the OWRC upon request. The Water and Well Management Branch should monitor general conditions in the area especially during the initial period of production pumping. The data obtained will permit a comparison of the anticipated and actual effects of production pumping and be the basis for modifications to the terms and conditions of the Permit and an evaluation of claims of interference.

January 27, 1972.

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APPENDIX A

Streamflow Measurements in the
Hunsburger Creek Study Area, 1971.

APPENDIX A

Streamflow Measurements in the Hunsburger Creek Study Area, 1971.

Drainage Basin	Station	Rating	Stream Gauging Method	Location	Streamflow Measurements cfs											
					June				July	August			Sept.	October		
					8	10	17	30	20	4	17	27	23	6	14	21
Baden Creek	B-1	Fair	Meter	South of Road		2.46	2.40	2.56	2.25							
	B-2	Fair weedy	Meter in summer	North of Road		2.90	2.48	2.70								
	B-3	Fair	Meter or weir	At Road		0.29		0.29	0.24			0.22				
	B-4							N.F.	N.F.							
	B-5														Est. 15-30 IGPM	
	B-6					Trace	Trace	Trace	Trace						N.F.	
	B-7					N.F.		N.F.	N.F.						N.F.	
	B-8															N.F.
Tributary of Nith River	N-1														Est. 2-5 IGPM	
Hunsburger Creek	H-1	Good	Auto Weir and Meter	Just south of Road	5.46	4.55	4.33	4.21								
	H-4	Fair	Meter	~100' E. of Rd.		2.74	2.12	2.38	2.09		2.03		2.35			
	H-4(1)	Good	Meter	~150' above Junction										0.79		
	H-4(2)	Good	Meter	~100' above Junction										1.37		
	H-4(3)	Good	7-gallon bucket	At dam										0.176		
	H-4(4)	Fair	7-gallon bucket	At dam in In-flow to pond										0.271		
	H-4(5)	Fair-Good	Weir	Inflow to pond										0.064		
	H-4(6)	Fair	Meter - should use weir	Just south of road		0.17		0.25								

APPENDIX A

Streamflow Measurements in the Hunsburger Creek Study Area, 1971.

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Drainage Basin	Station	Rating	Stream Gauging Method	Location	Streamflow Measurements cfs											
					June				July	August			Sept.	October		
					8	10	17	30	20	4	17	27	23	6	14	21
Hunsburger Creek	H-2	Good	Meter	Just west of Road		2.14	1.99	2.02	1.89		1.93		2.06			
	H-2(1)	Good	1-gallon bucket	East end of culvert										1 IGPM		
	H-3	Fair	Meter	~150 yds. south of Road		1.75	0.09		0.50	0.48	0.67		0.39			
	H-3(1)	Fair - Good	Weir	~80 ft. above junction										0.158		
	H-3(2)	Fair - Good	Weir	~80 ft. above junction											0.216	
	H-3(3)	Good	2.55-gal-lon bucket	West end of culvert				Est. ~1 IGPM	Est. ~1 IGPM		Est. ~1 IGPM				3.91 IGPM	
	H-5	Good	Flume	Just west of road	1.66	1.40	1.63	1.78	1.66	1.44	1.40	1.70	1.61			
	H-5(1)	Poor - Fair	Meter	Just west of culvert beside road		0.97		0.92			0.71					
	H-5(2)	Fair	Meter - should be weir	Just east of culvert beside road		0.16		0.16								
	H-5(3)	Good	Weir	In ditch up-stream from the Westerly underground pipe										0.098		
	H-5(4)	Good	7-gallon bucket	At culvert										0.201		
	H-5(5)	Good	7-gallon bucket	At dam										0.035	0.036	
	H-5(6)															

APPENDIX A

Streamflow Measurements in the Hunsburger Creek Study Area, 1971.

Drainage Basin	Station	Rating	Stream Gauging Method	Location	Streamflow Measurements cfs											
					June				July	August			Sept.	October		
					8	10	17	30	20	4	17	27	23	6	14	21
Hunsburger Creek	H-5(7)	Good	Weir	100 ft. from new highway (north)										0.057		
	H-5(8)	Fair	Meter or Weir	Upstream from junction		0.25		0.191								
Alder Creek	A-1	Fair-Good	Meter	Southwest of House	Sept. 8/71 0.32											
	A-2			East of North-South Tributary												
	A-3		Meter		Aug. 5/71 2.70											
	A-4															

APPENDIX B

Water Level Measurements in Hofstetter Lake, 1971.

APPENDIX B

Water Level Measurements in Hofstetter Lake, 1971.

OBSERVER: H. J. Peper

STATION: HOFSTETTER LAKE

ADDRESS: R. R. 2, PETERSBURG

LOCATION: WILMOT TOWNSHIP

YEAR: 1971

MONTH: MAY

DATE	TIME	READING	COMMENTS	DATE	TIME	READING	COMMENTS
3	6:30pm	1.49		22	6:30pm	1.42	
4	6:30pm	1.49		23	12:00n	1.41	
5	6:30pm	1.48		24	5:00pm	1.42	
6	6:30pm	1.49		25	7:00pm	1.41	
7	7:30pm	1.49 -		26	6:30pm	1.42	
8	6:30pm	1.49 -		27	6:30pm	1.42	
9	6:15pm	1.48		28	6:45pm	1.43	
10	6:35pm	1.48		29	11:30am	1.42	
11	6:30pm	1.47		30	11:45am	1.43	
12	7:05pm	1.47		31	6:30pm	1.42	
13	6:30pm	1.47					
14	6:15pm	1.46					
15	6:30pm	1.46					
16	3:30pm	1.45					
17	5:30pm	1.44					
18	8:00am	1.43					
19	6:30pm	1.42					
20	6:30pm	1.42					
21	6:40pm	1.42					

- NOTE: 1. Please take one water-level measurement daily and record time of measurement.
2. Comment on local conditions such as weather, damage to staff gauge, flooding, change in measuring point, etc.

APPENDIX B

Water Level Measurements in Hofstetter Lake, 1971.

OBSERVER: H.J. Taper

STATION: Hofstetter Lake

ADDRESS: R.R. 2 Petersburg

LOCATION: Wilmot Township

YEAR: 1971

MONTH: JUNE

DATE	TIME	READING	COMMENTS	DATE	TIME	READING	COMMENTS
June 1	6:30pm	1.42		June 20	10:00am	1.39	
June 2	5:45pm	1.43		June 21	6:30pm	1.38	
June 3	8:30am	1.42		June 22	6:30pm	1.39	
June 4	6:30pm	1.43		June 23	6:30pm	1.38	
June 5	6:45pm	1.43		June 24	6:30pm	1.37	
June 6	6:45pm	1.44		June 25	7:00pm	1.37	
June 7	6:30pm	1.44		June 26	6:30pm	1.36	
June 8	6:30pm	1.44		June 27	10:30am	1.35	
June 9	6:30pm	1.43		June 28	6:00pm	1.35	
June 10	6:45pm	1.43		June 29	6:30pm	1.34	
June 11	7:00pm	1.43		June 30	6:30pm	1.33	
June 12	8:30pm	1.42					
June 13	10:00am	1.43					
June 14	6:30pm	1.42					
June 15	6:30pm	1.42					
June 16	6:00pm	1.41					
June 17	6:30pm	1.41					
June 18	6:30pm	1.40					
June 19	6:30pm	1.40					

- NOTE: 1. Please take one water-level measurement daily and record time of measurement.
2. Comment on local conditions such as weather, damage to staff gauge, flooding, change in measuring point, etc.

APPENDIX B

Water Level Measurements in Hofstetter Lake, 1971.

OBSERVER: H.J. Peper

STATION: Hofstetter Lake

ADDRESS: R.R. 2 Petersburg

LOCATION: Wilmot Township

YEAR: 1971

MONTH: July

DATE	TIME	READING	COMMENTS	DATE	TIME	READING	COMMENTS
July 1	6:30pm	1.32		July 20	6:45pm	1.29	
July 2	6:30pm	1.32		July 21	6:30pm	1.29	
July 3	6:30pm	1.32		July 22	6:30pm	1.29	
July 4	9:30am	1.31		July 23	8:00am	1.29	
July 5	6:30pm	1.31		July 24	8:30am	1.28+	
July 6	6:30pm	1.32		July 25	6:45pm	1.28+	
July 7	6:45pm	1.31		July 26	6:15pm	1.28	
July 8	6:30pm	1.30		July 27	6:30pm	1.28	
July 9	7:00pm	1.30		July 28	6:15pm	1.28	
July 10	7:00pm	1.29		July 29	6:30pm	1.27	
July 11	10:00am	1.29		July 30	6:30pm	1.27	
July 12	7:30pm	1.30		July 31	9:30am	1.28	
July 13	6:30pm	1.30					
July 14	6:30pm	1.29					
July 15	7:00pm	1.30					
July 16	6:15pm	1.30					
July 17	8:30pm	1.29					
July 18	7:00pm	1.29+					
July 19	7:15pm	1.30					

NOTE: 1. Please take one water-level measurement daily and record time of measurement.
2. Comment on local conditions such as weather, damage to staff gauge, flooding, change in measuring point, etc.

APPENDIX B

Water Level Measurements in Hofstetter Lake, 1971.

OBSERVER: H.J. Peper

STATION: Hofstetter Lake

ADDRESS: R.R. 2 Petersburg

LOCATION: Wilmot Township

YEAR: 1971

MONTH: August

DATE	TIME	READING	COMMENTS	DATE	TIME	READING	COMMENTS
Aug. 1	6:30pm	1.27		Aug. 20	8:15am	1.26	
Aug. 2	7:00pm	1.27		Aug. 21	6:30pm	1.25	
Aug. 3	8:30am	1.27		Aug. 22	6:30pm	1.26	
Aug. 4	6:30pm	1.27		Aug. 23	6:15pm	1.26	
Aug. 5	7:00pm	1.26		Aug. 24	6:30pm	1.26	
Aug. 6	6:30pm	1.26		Aug. 25	7:00pm	1.26	
Aug. 7	6:30pm	1.27		Aug. 26	6:30pm	1.27	
Aug. 8	7:00pm	1.26		Aug. 27	6:45pm	1.27	
Aug. 9	6:30pm	1.26		Aug. 28	6:30pm	1.26	
Aug. 10	6:30pm	1.26		Aug. 29	7:45am	1.27	
Aug. 11	5:15pm	1.25		Aug. 30	6:30pm	1.27	
Aug. 12	6:30pm	1.25		Aug. 31	6:45pm	1.27	
Aug. 13	6:45pm	1.26					
Aug. 14	10:00am	1.26					
Aug. 15	6:30pm	1.26					
Aug. 16	6:30pm	1.26					
Aug. 17	6:15pm	1.25					
Aug. 18	6:30pm	1.25					
Aug. 19	6:30pm	1.25					

- NOTE: 1. Please take one water-level measurement daily and record time of measurement.
2. Comment on local conditions such as weather, damage to staff gauge, flooding, change in measuring point, etc.

APPENDIX B

Water Level Measurements in Hofstetter Lake, 1971.

OBSERVER: H.J. Peper

STATION: Hofstetter Lake

ADDRESS: R.R. 2 Petersburg

LOCATION: Wilmot Township (Waterloo
County)

YEAR: 1971

MONTH: September, 1971

DATE	TIME	READING	COMMENTS	DATE	TIME	READING	COMMENTS
Sept. 1	6:30pm	1.27 -		Sept. 20	6:30pm	1.28	
Sept. 2	6:45pm	1.27 +		Sept. 21	7:00pm	1.28	
Sept. 3	6:30pm	1.27 -		Sept. 22	6:30pm	1.27	
Sept. 4	6:30pm	1.26		Sept. 23	6:30pm	1.27	
Sept. 5	8:30pm	1.30	extremely heavy rain	Sept. 24	7:15pm	1.27	
Sept. 6	6:30pm	1.30		Sept. 25	6:45pm	1.26	
Sept. 7	6:30pm	1.29		Sept. 26	8:45pm	1.26	
Sept. 8	7:00pm	1.29		Sept. 27	6:30pm	1.27	
Sept. 9	6:15pm	1.29		Sept. 28	7:30pm	1.27-	
Sept. 10	6:15pm	1.29		Sept. 29	6:30pm	1.27	
Sept. 11	6:30pm	1.28		Sept. 30	8:15am	1.27 +	
Sept. 12	8:15am	1.28					
Sept. 13	6:30pm	1.27					
Sept. 14	6:00pm	1.27					
Sept. 15	5:00pm	1.27 +					
Sept. 16	5:30pm	1.28					
Sept. 17	6:30pm	1.28					
Sept. 18	6:15pm	1.28					
Sept. 19	6:30pm	1.28					

- NOTE: 1. Please take one water-level measurement daily and record time of measurement.
2. Comment on local conditions such as weather, damage to staff gauge, flooding, change in measuring point, etc.

APPENDIX C

Reported Conditions in Hofstetter Lake, 1963-1970.

APPENDIX C

Reported Conditions in Hofstetter Lake, 1963-1970.

(COPY OF ORIGINAL)

Petersburg, Ontario,
February 14, 1970.

Attn: Mr. J. Viirland.

REGISTERED MAIL

Mr. C. W. Heipel,
Township Clerk & Treasurer,
Township Offices,
Baden, Ontario.

Dear Mr. Heipel:

In response to an article in the Kitchener-Waterloo Record regarding the drilling of wells by the City of Kitchener in the Township of Wilmot, I must say that I have been keeping a record of the water level of Hofstetter Lake. I have been very interested in this lake since I acquired the property some years ago, and you must realize that if this body of water dries up into a stinking swamp, the value of my home and land will be less than the square root of zero to myself or anyone else.

You are aware, I suppose, that this lake is entirely spring-fed with the exception of surface run-off water which may find its way to the lake from the immediate area after a heavy rain or snow-melt.

In the summer of 1967, from July 18th to September 7th, I noticed that the water ceased to flow entirely from the lake through a small stream which meanders through my property.

In 1968 the water ceased to flow from lake outlet sometime between June 15th and June 23rd. I have these dates fixed, since June 15th is my birthday and I know I checked the water then and it was still running. My next log entry was on June 23rd and only a mucky stream bed remained.

I constructed a small earthen dam about 2 feet high prior to the onset of the 1968/69 winter. Lake water in the spring of 1969 rose throughout March, April and May but remained

(Continued)

steady throughout June. No water flowed out during these months up to and including November, 1969, with the exception of a flushing to clear accumulated algae in mid-August. I wish to point out that, although no water issued from the lake during all these months, the lake level dropped 14 inches.

Now I do realize that considerable water is lost due to evaporation in the summer months, but during the years of 1963, 1964, 1965, and 1966, water always flowed from the lake. I have no records previous to this, since I only acquired the property in 1962.

I will be keeping a check on the lake level again in 1970 as well as a record of snow and rainfall in this area with corresponding dates, and if the lake continues to drop in level below previous years, I will seek legal counsel.

Since a good deal of the farm area in this part of Wilmot Township consists of fairly sandy soil, it is my humble opinion that one of the most valuable assets of this township is being literally "drained away" and serious consideration should be given to the long-term effects of further wood-lot removal and water pumping.

I believe that Nature has given us the signs. Let us be intelligent enough to act now to avoid the penalty of misuse.

Yours respectfully,

"H. J. PEPPER"

HJP:RP

H. J. Peper.

APPENDIX D

Sample Water Use Inventory Questionnaire

QUESTIONNAIRE

Appendix D

RIPARIAN OWNER Date

DOMESTIC SUPPLY

- What is the source of drinking water in your home?
(well, springs, cistern, surface water, other (specify))
- Is this supply considered reliable? Yes No
- If not reliable, describe problem.
.....

OTHER SUPPLIES

- Is water used for purposes other than domestic supply?
 - Stock watering - how many? what kind? are the stock watered here all year?
.....
 - Crop or Garden watering -
details
.....
 - Bathing - Any adverse effects from body contact (swimmer's itch, rashes,
pinkeye, etc.)
.....

POND SOURCES

- Fish Ponds -
 - Stocked or naturally occurring species? Have Fish Kills occurred? Any Fish
Kills over the winter?
- Aesthetic Ponds -
 - Any water quality deterioration? Is it a seasonal problem? How many years has
this occurred?
- For all ponds -
 - Source (on-stream, formed by damming, by-pass, off-stream.)
 - Approximate dimensions and depth.
 - Have pesticides been used? For weed, algae or leech control or coarse fish
removal?

ADDITIONAL COMMENTS

.....
.....

Interviewer

APPENDIX E

Water Use Data Forwarded to the Biology Branch from
the Water and Well Management Branch

APPENDIX E

Data forwarded to the Biology Branch in a memorandum dated October 5, 1971.

- information was obtained regarding the water uses of 117 households. Ninety-four householders were personally interviewed.
- it was determined from interviews that neither the stream nor stream water is used extensively for swimming (excluding Holiday Beach Resort). Only eight families reported use of the stream for bathing. There are no reports of adverse effects from body contact with the water.
- there are six landowners in the basin with improved fish ponds; one of these is presently under construction and not yet in operation. Only one of the five established fisheries has experienced kills (Mr. Hollman) and this was determined to be due to poor aeration of the excavated pond.
- artificial feeding is common, especially in those ponds stocked with rainbow trout.
- W. Habel reported that a fish kill occurred in the lower reaches of Hunsburger Creek near his property at lot 16, concession 1, Block A, Township of Wilmot. This was allegedly the result of an accidental spill of pig manure upstream from this location. The Department of Lands and Forests was apparently informed of this kill.
- of 11 landowners with recreational ponds on their property, only two report any noticeable water quality deterioration. R. Hamacher (lot 14, concession NBR) reports weed growth (fox tail) in this fish pond in recent years. The water is of sufficiently high quality to support rainbow trout. However, D. Roedding (lot 13, concession 1, Block A) expressed concern about barnyard runoff entering the tributary to Hunsburger Creek feeding an on-stream pond being constructed on his property. As he had not begun to take water at the time of the investigation there was no substantial evidence of water quality deterioration.
- several landowners, in both upstream and downstream locations, successfully maintain wildlife sanctuaries.

- there were no reported cases of the use of pesticides directly on ponds or streams. Atrazine is widely used for application on corn crops, and 2-4-D has been used in the past. These pesticides could conceivably run off into watercourses.
- the Agricultural Representative for Waterloo County, G. H. Thompson, was contacted. To his knowledge, there had been no complaints referred to his office relating to the water resources of the study area.
- the Waterloo County Health Unit has monitored biological quality of the reservoir at Holiday Beach since 1969. On June 28, 1971, total coliform count reached 3,000; faecal coliform was 300.

APPENDIX F

Results of Water Quality Analyses at Holiday Beach

APPENDIX F

Results of Water Quality Analyses at Holiday Beach

Information was obtained from Mr. Burnsteel, Health Inspector, regarding bacteriological quality of water at Holiday Beach. The following sample results were obtained.

	<u>Total Coliform</u>	<u>Faecal Coliform</u>
July 16, 1969.		
Sample 1	200	70
Sample 2	60	40
Sample 3	45	30
Sample 4	20	20
Sample 5	45	42
August 7, 1969.	6	6
June 8, 1970.		
Sample 1	350	not analysed
Sample 2	660	not analysed
Sample 3	640	not analysed
Sample 4	900	not analysed
May 20, 1971.	1800	8
June 24, 1971.	700	22
June 28, 1971.		
Sample 1	3000	300
Sample 2	800	400

	<u>Total Coliform</u>	<u>Faecal Coliform</u>
July 8, 1971.		
Sample 1	200	72
Sample 2	800	72
Sample 3	6	0
July 15, 1971.		
Sample 1	300	100
Sample 2	38	28
July 29, 1971.		
Sample 1	700	200
Sample 2	400	86
August 5, 1971.		
Sample 1	16	20
Sample 2	10	16

Extensive growths of algae were observed in the pond in late May and early June.

According to Ontario Water Resources Commission Water Quality guidelines (Microbiological Criteria) "Water used for body contact recreational activities should be free from pathogens including any bacteria, fungi or viruses that may produce enteric disorders or eye, ear, nose, throat and skin infections. Where ingestion is probable, recreational waters can be considered impaired when the coliform, fecal coliform, and/or enterococcus geometric mean density exceeds 1000, 100 and/or 20 per 100 ml, respectively, in a series of at least ten samples per month."

APPENDIX G

Types and Numbers of Benthic Organisms Collected at
Three Locations on Hunsburger Creek
in June, July and September, 1971.

APPENDIX G

Numbers and Types of Benthic Organisms Collected at Three Locations on Hunsburger Creek in June, July and September, 1971.

ORGANISMS	S T A T I O N								
	June	1 July	Sept.	June	2 July	Sept.	June	3 July	Sept.
Stoneflies (unident)	1			1					
Mayflies					P				
<u>Baetis</u>	P	79	160	4		1			
<u>Caenis</u>	2						P		
<u>Paraleptophlebia</u>				76					
<u>Stenonema</u>				4		5	1		
Caddisflies (unident)			P						
<u>Cheumatopsyche</u>				12	3	1	8	65	110
<u>Chimarra</u>				8	34	13			
<u>Helicopsyche</u>								9	
<u>Hydropsyche</u>			7	6	4		3	44	24
<u>Lepidostoma</u>	P								
<u>Limnephilus</u>	P	P	3						
<u>Psychoglyphia</u>		P							
<u>Psychomyiidae</u>							1		
<u>Rhyacophila</u>				8	3	2			
<u>Sortosa</u>				11		11			
pupae	3		P						
Helgramites									
Corydalidae				2	2	2			

APPENDIX G

Numbers and Types of Benthic Organisms Collected at Three Locations on Hunsburger Creek in June, July and September, 1971.

ORGANISMS	S T A T I O N								
	June	¹ July	Sept.	June	² July	Sept.	June	³ July	Sept.
Dragonflies (unident)							P		P
Damselflies (unident)							P		P
Trueflies									
Chironomidae	P	5	5	2	1		5	18	1
Ceratopogonidae	P	P					P		
Empididae			1						
Simuliidae		51	87	1					
Tabanidae	P	2	3	1					
Tipulidae		8	4	4	1		7	3	
Beetles	1								
Dytiscidae	P		1						
Elmidae				5	1				2
Psphenus							1	1	
unident. adults	2	4	P	2			6	12	12
Bugs									
Corixidae		P						P	P
Notonectidae		1					P		

APPENDIX G

Numbers and Types of Benthic Organisms Collected at Three Locations on Hunsburger Creek in June, July and September, 1971.

ORGANISMS	S T A T I O N								
	June	¹ July	Sept.	June	² July	Sept.	June	³ July	Sept.
Amphipods	1								
<u>Hyalloa azteca</u>	P			P			P	P	
<u>Crangonyx</u>	P		P						
Isopods									
<u>Lirceus</u>							P		
Crayfish									
<u>Orconectes propinquus</u>							P	P	P
<u>Cambarus robustus</u>					2				
Snails	2								
<u>Physa</u>	P	4	P				P	1	P
<u>Helisoma</u>							P		P
Clams									
<u>Sphaerium</u>	P			2	34	P	P	P	P
<u>Pisidium</u>	P		P						
Flatworms			P	1		P	P	1	4

APPENDIX G

Numbers and Types of Benthic Organisms Collected at Three Locations on Hunsburger Creek in June, July and September, 1971.

ORGANISMS	S T A T I O N								
	June	1 July	Sept.	June	2 July	Sept.	June	3 July	Sept.
Leech									
Sp.A	P	1	1						
Sp.B		P	2						
Worms									
Tubificidae	4	4	6				P	1	
Lumbriculidae			1				P		
Total Taxa	17	14	17	18	11	9	21	13	12
Total Organisms	16	164	281	150	85	35	32	155	153

APPENDIX H

Types and Numbers of Fish Collected from Two Stations
on Hunsburger Creek in June and July, 1971.

APPENDIX H

Types and Numbers of Fish Collected from Two Stations on
Hunsburger Creek in June and July, 1971.

F I S H	S T A T I O N			
	² June July		³ June July	
White sucker	45	61	13	16
Hog sucker		10	1	15
Northern redhorse sucker			2	
Fathead minnow	1			
Bluntnose minnow	2		1	
Common shiner		2	18	4
Creek chub	9	14	3	4
Horneyhead chub			5	
Redbelly dace	1	10		
Blacknose dace	25	18		
Stone cat			5	
Rock bass			2	7
Fantail darter			3	
Johnny darter			1	1
Mottled sculpin	5	3		
Brassy minnow		1	1	
Brook trout	1			
American brook lamprey	17	8		
No. Species	9	9	11	7
No. Individuals	106	127	50	52

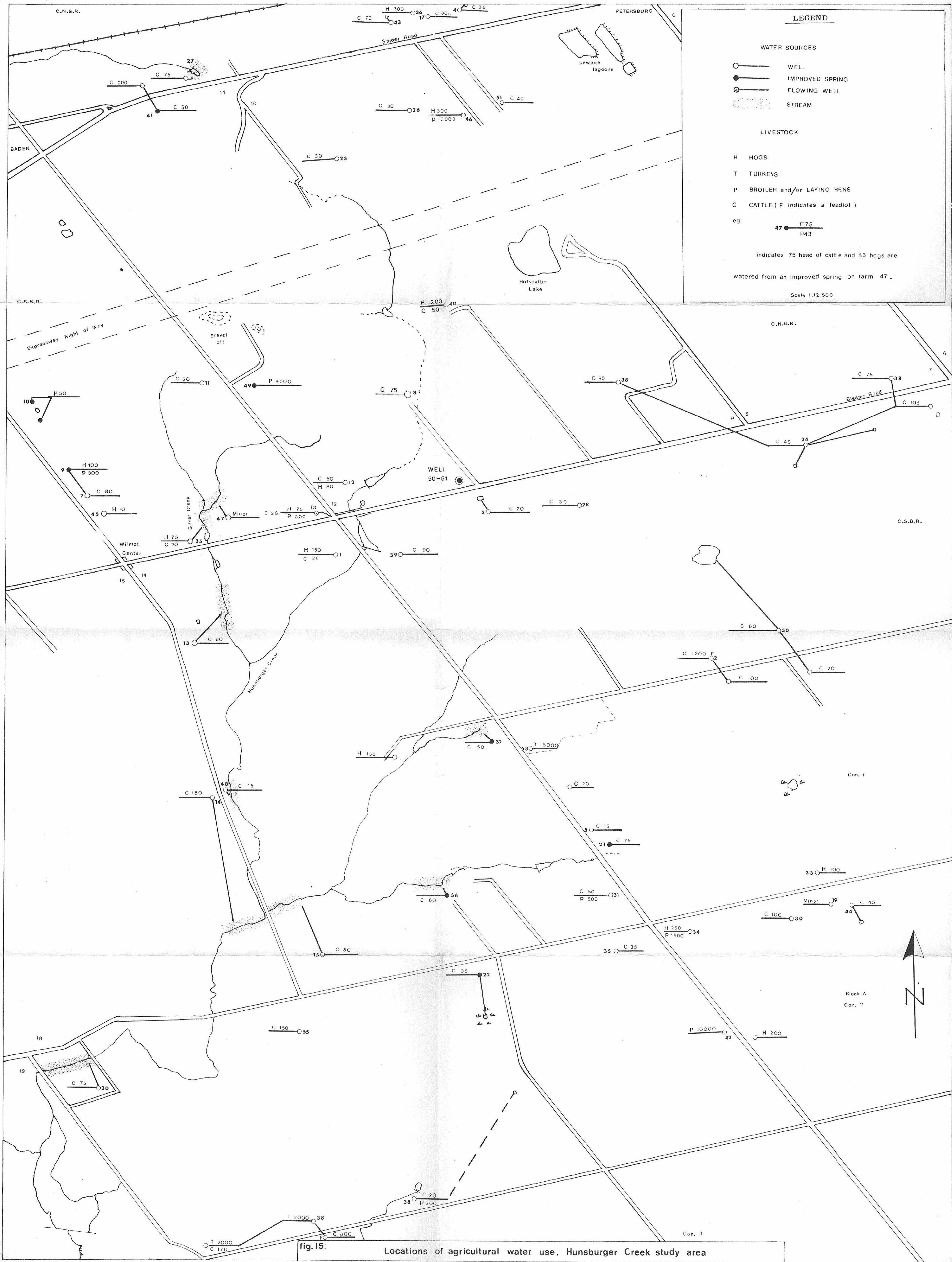


fig. 15: Locations of agricultural water use, Hunsburger Creek study area

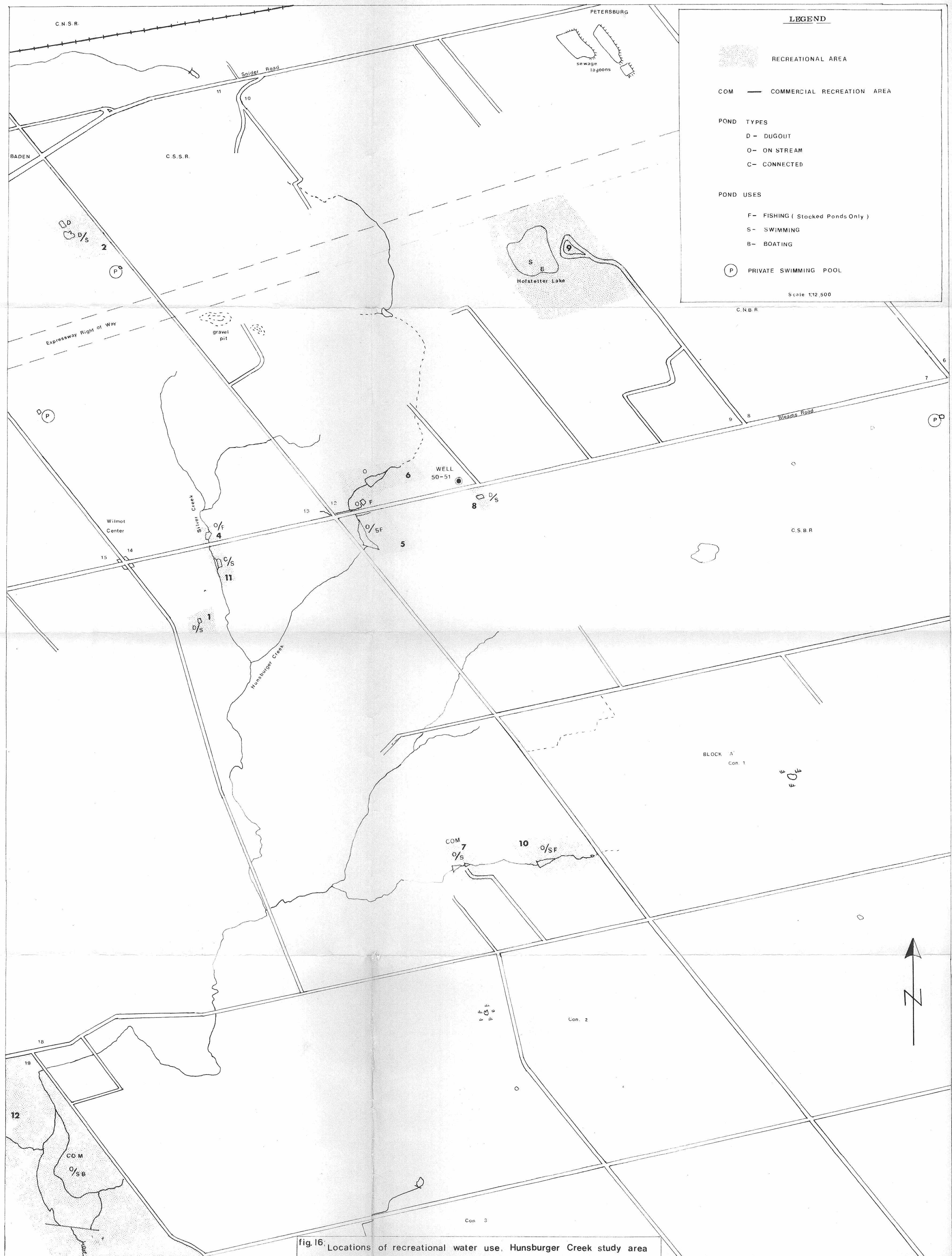


fig. 16. Locations of recreational water use, Hunsburger Creek study area



(15960)

MOE/KIT/REP/APKC

Date Due

MOE/KIT/REP/APKC + 2 maps
Ontario Water Resources Co
Report on the
proposed operation apkc
 c.1 a aa

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